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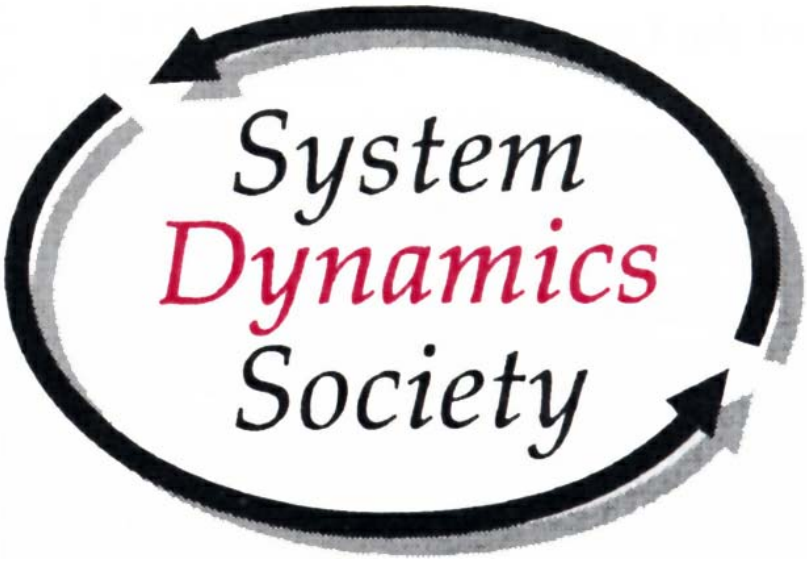

July 23 – 27, 2006
Nijmegen, The Netherlands

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Methodology Department
Nijmegen School of Management
Radboud University Nijmegen
The Netherlands

Conference Partners:
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Tilburg, The Netherlands

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Edited by:
Andreas Größler
Etiënne A. J. A. Rouwette
Robin S. Langer
Jennifer I. Rowe
Joan M. Yanni

Proceedings
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24th International Conference
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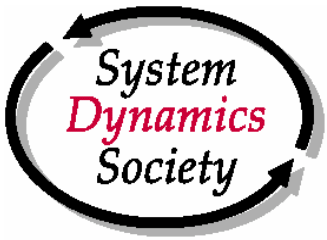

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Conference Venue Floor Plan ..... Handout

Welcome

Dear Colleagues,

Welcome to the 24th International Conference of the System Dynamics Society. This year the conference will be held in Nijmegen. Nijmegen is the Netherlands' oldest city and celebrated its 2000th anniversary in 2005. The city offers historic sites and museums and borders beautiful forest countryside and polder landscapes, our unique low-lying terrains that have been reclaimed from water and are protected by dikes.

This year again the program shows that the field of system dynamics is thriving. Conference participants come from over 40 different countries from all over the world. Over the next four days you will have a chance to listen to and discuss system dynamics work presented by leading practitioners from various application areas.

The conference theme is "The dynamics of innovation in networks". The special Business Day on Wednesday is devoted to this topic. This year's conference will comprise a full schedule including a number of special events such as workshop sessions, panel discussions, chapter and special interest group meetings, roundtables, student colloquia, award ceremonies, the SD CareerLink bulletin board, the "Peer Review" dialog, vendor displays, exhibits and demonstrations, software users' group meetings, and of course Society business meetings.

To further increase your enjoyment of the conference we have also scheduled a variety of social events including an informal gathering during registration, a welcome reception, a social hour and a conference banquet. We welcome those who may be accompanying conference participants but not attending the formal sessions. We hope that you will take part in the special events and enjoy the attractions of Nijmegen. There will be organized activities such as guided tours including a Roman tour of Nijmegen or a polder biking tour, as well as a visit to the High Field Magnetic Laboratory or the Astrophysics department (and the telescope-park) at Radboud University.

This year nearly 350 volunteer reviewers screened and commented on submissions. In addition, dozens of volunteers worked many hours to ensure a successful conference. Without their commitment our conference would be impossible. A special thanks goes to all who helped.

In addition to all our other sponsors and our conference host, the Methodology Department of Radboud University Nijmegen, we are also very fortunate this year to have two conference partners, Minase BV and Ventana Systems, Inc. We sincerely appreciate the enthusiasm and support of all our sponsors.

We hope that you find the conference stimulating and rewarding. We ask that you bring to our attention anything that may help us to ensure the success of the current conference, as well as future ones.

Best wishes from the conference organizing committee,

Etiënne Rouwette, Jac Vennix, Andreas Größler, Jack Homer and Roberta Spencer

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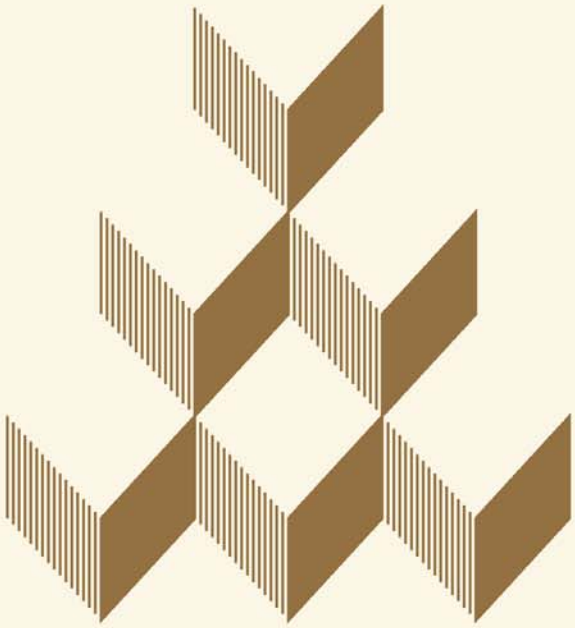

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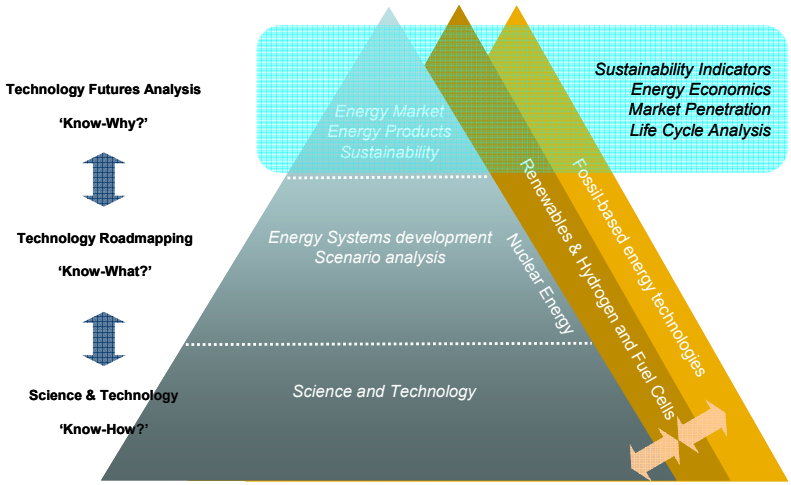

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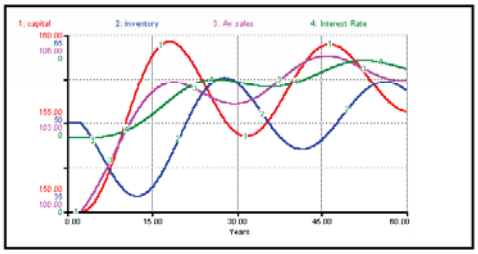

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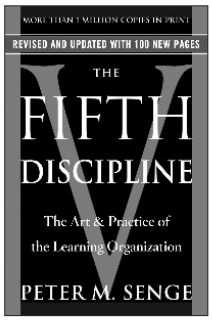

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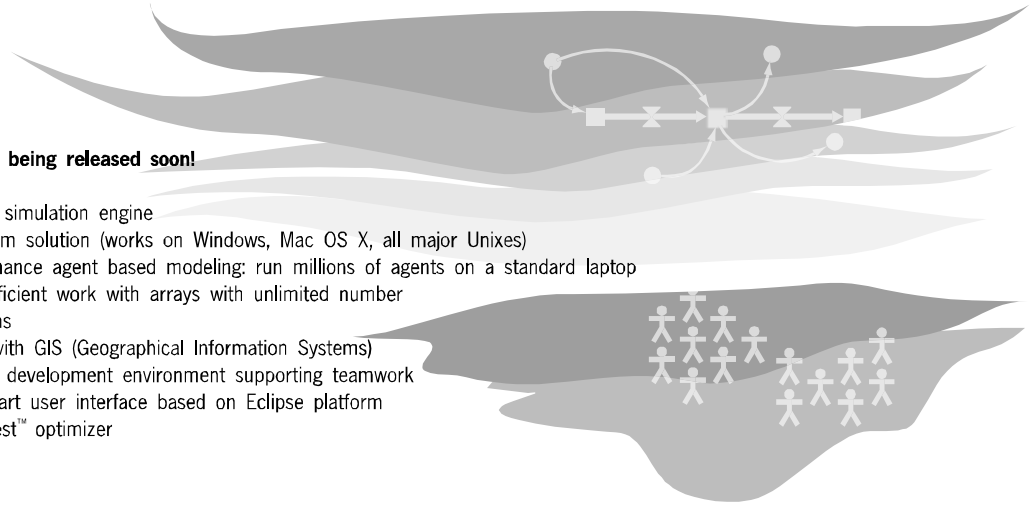

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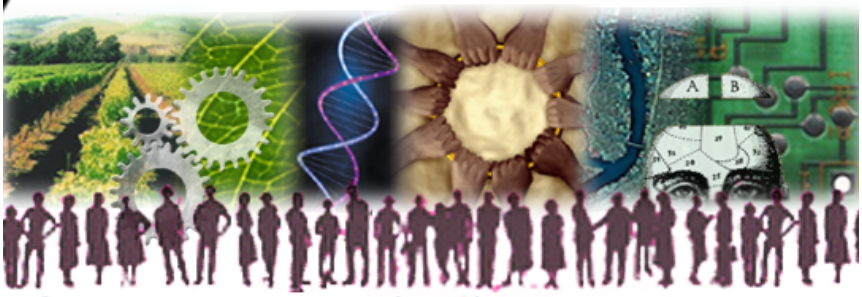

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What is it? The *SD Career Link*, in its ***seventh*** year of operation, is hosted by the System Dynamics Society at the University at Albany. It includes on-line information and links to organizations who employ candidates with system dynamics and systems thinking backgrounds. We hope that the *SD Career Link* will provide a valuable exchange of information about organizations, positions and people in the field of system dynamics. Please visit the *SD Career Link* bulletin board at the conference.

Career Link Allows Companies and Universities to Describe General Career Information as Well as Specific Job Opportunities. The Career Link section of the Society web site has two subsections: (1) career information; and (2) specific job postings. In the career information section, employers and universities provide general descriptive information about how system dynamics fits into their organization, typical jobs, career paths, and other aspects of employment with the company. This subsection allows employers to provide information about system dynamics opportunities within their firms to supplement the more general information contained on their corporate or academic websites. Such career information is valuable to those interested in studying system dynamics, and we urge companies and universities to describe system dynamics in their organization even if they do not have specific open jobs at the present time. The subsection on specific job postings allows employers to advertise active openings.

How to participate? Please refer to the System Dynamics Society website at www.systemdynamics.org/ or send an email message to the Society office at <system.dynamics@albany.edu>. All information about access to and use of the site will remain confidential. We look forward to your participation.

Announcing the Twenty-fifth International System Dynamics Conference Boston, Massachusetts, USA July 29 – August 2, 2007

2007 marks the 25th annual conference of the System Dynamics Society and the 50th anniversary of the founding of the field. In celebration, the conference will feature a number of special events marking these important milestones. Join us for this wonderful occasion!

The venue for the 2007 conference of the System Dynamics Society will once again be the Seaport Hotel in the heart of Boston's Seaport District overlooking Boston Harbor.

The Seaport Hotel features elegant guest rooms in Boston's World Trade Center, each with a breathtaking panoramic view of Boston Harbor or the city skyline. This site was chosen for many reasons, including the hotel's convenient location near Boston's financial district and Back Bay, restaurants, shops, museums and attractions, and only minutes from Boston's Logan International Airport.

Of most importance to our conference attendees, the Seaport conference facilities are excellent! Public spaces have complimentary Wi-Fi access and each guest room is equipped with complimentary Internet/VPN access at T-1 speed. This will provide a wonderful venue for all programs and sessions.

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For detailed information about the Seaport Hotel please visit:
http://www.seaportboston.com

Watch for further announcements and details as they develop.
Visit our website: http://www.systemdynamics.org

Reading Supporting Material

Supporting Material files can be found by clicking on the appropriate link in the *Paper Index*, found on the conference website. Papers are listed alphabetically by the last name of the primary author.

- **Viewing/Opening/Reading the Supporting Material:**

Some of these files are plain text files or presentations which are in widely accessible formats such as .doc, .ppt, .pdf, etc., but others are model files, which need to be viewed using the appropriate system dynamics modeling software. Below, find information on how to access freeware/demo/trial versions from several system dynamics software manufacturers. Follow the links within the descriptions below to the software needed to view the files.

In following chart, find the three-letter extension of the file name, then the software you need to view the file.

File Name Extension	Software Needed
.itm, .stm	iThink, STELLA*
.sip	Powersim Studio
.sim	Powersim
.vmf, .vpm, mdl	Vensim

*ithink and STELLA can each be used to open both .itm and .stm files.

STELLA/ithink by isee systems (formerly High Performance Systems):
http://www.iseesystems.com/softwares/player/iseeplayer.aspx

This link will navigate you to the FREE isee Player. The isee Player lets you view, run, print and share both STELLA and iThink models. Available in both Windows and Macintosh versions, the isee Player allows exploration of all model layers - map, model, equation, and interface, and never "times out."

Powersim Studio by Powersim Solutions:
http://www.powersimsolutions.com/SDConference2006/sdconference.asp

Powersim Studio Express is a 60-day trial version of Powersim Studio 2005. Note that this installation will automatically replace any previous version of Studio 2000, 2001 or 2003 that is installed on the computer. Studio 2005 can open files from earlier versions of Studio, but earlier versions cannot open a file that has been updated or created in Studio 2005. Studio 2005 contains an array of new and exciting features, including tools for optimization and risk analysis, number formatting, new user assistance features, the ability to customize the user interface, and more.

Vensim by Ventana Systems:
http://www.vensim.com/reader.html

The Vensim Model Reader can be used to open Vensim models which are files with extension .vmf or .vpm. This is free software which will allow you to view and simulate models changing the assumptions but not model structure. Many models (.vmf, .vpm and .mdl) can also be opened using Vensim PLE which is free for educational use. Both PLE and the Reader are available from:
http://www.vensim.com/freedownload.html

Papers: Parallel, Poster and Focused Research Sessions

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A system dynamics computer-based learning environment for the formulation of manufacturing strategy

The paper discusses how a Computer Based Learning Environment (CBLE), which is based on a system dynamics model, can form the basis of strategy formulation processes at the operations level. The rationale behind, the structure and the elements of the SYDMAS CBLE, as well as its embedment in a scenario-driven manufacturing strategy formulation process are presented. Through a use case, it is shown how the CBLE can enhance the manufacturing strategy formulation process by providing a dynamic perspective and by effectively supporting the related social and knowledge processes.

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The Application of System Dynamics Simulation to Volatile System Management

One of the most volatile market environments of our time is the energy business. Whether the energy medium is gasoline, electricity, or natural gas, traditional market forces do not seem to exert the same influences as in other markets. Indeed, the behavior of the energy market sometimes seems to defy traditional understanding of the law of supply and demand. Management of, and survival within, such a system requires deep understanding of the system's potential behaviors under many different scenario settings. System Dynamics (SD) is posited as the most appropriate first methodology to apply when a system with highly volatile behavior is under scrutiny. This paper presents the background and some of the lessons learned from projects in which SD simulation was applied to analyze and understand the highly volatile energy market. A natural gas strategic acquisition simulation provides a tool for examination of market dynamics with a focus on acquisition strategy, while a gasoline business simulation provides insights into the supply side of the energy business. The application of SD to volatile environment management is not new; the scale of these simulations, and some of the techniques used for design and rollout potentially make the projects unique.

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Testing a Generic Dynamic Theory of Collaboration in the World Trade Center Case

Researchers at University at Albany did twenty-nine in-depth interviews for gathering first-person accounts of activities, decisions, problems, and solutions of the World Trade Center response and recover process. A generic dynamic theory of collaboration is tested in this interview dataset. The theory is based on Luna-Reyes, et al.'s (2004) model on interagency collaboration. It's found that during the response and recovery processes participants developed several social accumulations (individual understanding, shared understanding, and relationships). These social accumulations again improved the effectiveness of the processes they were produced. They also increased the effectiveness of other processes in response and recovery effort. These findings are consistent with the generic dynamic theory of collaboration Luna-Reyes, et al. (2004) proposed. A system dynamics model is developed to discuss several different scenarios.

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Implanting Neural Network Elements in System Dynamics Models to Surrogate Rate and Auxiliary Variables

Rate variables and auxiliary variables in System Dynamics models are normally constructed using functional equations and or table functions. To construct functions, however, it is imperative to know the underlying relation between the independent variables and the dependent variable. This we know is not always an easy task. Indeed, in many differentially non-linear or chaotic situations this may be totally impossible. One may have to resort to less accurate representations if constrained to write relations as equations or tables. Neural Networks has been deployed in many fields to capture the underlying structural relations between variables in such situations through training schemes. When trained, Neural Networks may achieve generalization capabilities though literarily as black boxes. As Neural Networks models when trained can work online like a function, they can be easily implanted within System Dynamics models to compute rates or auxiliary variables. The idea in this article is, in situations were it is not possible or it is considerably difficult to construct explicit functions or tables, to deploy Neural Networks to surrogate fuctions. Neural Network models, here called elements, can be trained on actual data to capture the underlying functional relationships between input output variables and implanted as rates or auxiliary variables to carry out computation on line.

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Modeling the Evolution of National Road Procurement Strategies

Many transportation agencies have discovered that traditional highway contract administration procedures and project delivery methods do not meet current demands. In response, they are turning to alternative

contracting. Four trends are perceived in road management. First, with respect to project delivery, more and more projects are contracted for the whole life cycle of the road. Second, contractors are given increasingly more freedom or design space, as the indicators used for monitoring their work become less operational and more performance based. Third, governments follow a dual track strategy; managing a portfolio of directly and indirectly financed projects; dependent on the project characteristics. Fourth, contracts are granted for longer term. These innovative forms of contracting are expected to yield more flexibility in the road sector; more innovation, higher performance and consequently lower costs while keeping up service levels on public values. This paper presents how by using a combination of institutional economics theory and engineering design theory, our aim is to build a systems dynamics model that can capture the institutional context and is able to indicate what contracting practices are likely to occur and which ones are likely to succeed in view of the meeting the public values and demands.

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Application of the Dynamics of Systems in Alternative of Solution of the Garbage in the City of Huancayo

The city of Huancayo is located in the center of the Peru, with a problem in common, of the different municipalities that are in the whole journey of the river Mantaro, as treating the solid waste. Throw organic waste, inorganic to the river Mantaro; it is not a good solution for the Municipal administrations, because it is contaminated seriously to river, for the great quantity of waste that hurtles daily, besides already to be contaminated by the pollutants that are thrown by the center metallurgist of the Oroya. The sanitary filler was not a good alternative to solve this problem; Which is the best solution? is it a question that they cannot respond, the Municipalities that are located in the City of Huancayo; the constant disagreements among their administrators what they achieve is to continue prolonging the contamination of the rivers and of the environment. The present study has the purpose of giving to know each one of the agents involved inside of this problem and to provide alternative that satisfy to the affected parts.

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Using System Dynamics Modeling for Conditioning Process in Supply Chain

Conditioning is one of the methods used to address imbalances between supply and demand in supply chains. Under periodic review policy, when the imbalance is beyond certain threshold at conditioning time, some proactive measures could be taken at either demand or supply side or both. For instance, demand could be influenced through pricing (promotion); excessive building blocks could be consumed through component substitution; additional supply could be arranged through flexible contracts. We use System Dynamics to model different conditioning actions. Specifically, corresponding to change of situation, we adopt time period array to realize optimal control along timeline. Some simulation examples are presented to illustrate gradual correction of imbalance situation under different conditioning actions.

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A Preliminary System Dynamics Model of Insurgency Management: The Anglo-Irish War of 1916-21 as a Case Study

The aim of this paper is to demonstrate the potential of using the system dynamics computer simulation methodology to gain insight into the dynamic behavior of insurgencies. To this end, a basic model of insurgencies containing the dynamic mechanisms of incident suppression, insurgent creation, and war weariness is developed. The paper then shows how this model, properly adapted, can explain much of the behavior of insurgencies by examining the Anglo-Irish War of 1916-21. Then, to illustrate the potential usefulness of the system dynamics methodology to policy makers, the paper uses the model to determine which system parameters might have most affected the outcome of the Anglo-Irish War. As one example, the simulation suggests that the lack of British governmental legitimacy in Ireland may have hindered the simulated efficacy of insurgency suppression efforts. As another example, the paper shows how the effects of a "good works" policy might have aided insurgency suppression in Ireland by separating the insurgents from their supporting population. The paper then concludes by proposing how such a model and the system dynamics methodology in general might be developed to assist policy makers manage current insurgencies throughout the world.

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Causal Analyses: Debt and Structural Adjustment Programme

The impact of structural adjustment programme on the economic situation in many African countries can not be overemphasised. Over more than a decade of implementing neo-liberal economic policies by the Bretton Woods institution it is of great importance to document the lessons learnt. This paper explains how the expected effect of structural adjustment policies produced unintended effects which cut back the gains of the programme. Using causal analyses, the assumptions and hypotheses implicit in the six main structural adjustment policies are clearly elicited with a causal loop diagram. The paper concludes, though structural adjustment programme was not a complete failure, the policies generally did not deliver the expected promises due to lack of systematic analyses and understanding of the policy responses by stakeholders.

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Dynamic Skill Based Routing: a System Dynamics approach to a Policy Definition in Call Center Management

Service Systems are nowadays considered as the most profitable assets of both Private Companies and Public Organizations, since they offer a highly added value for many different kind of products, tangible and intangible. Among them, a Call-Center is considered to be as very

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difficult both to understand and hence to perfectly manage. This is mainly due to its intrinsic dynamics and to the unpredictable behaviour of input data. Furthermore, modern Call-Centers tend to focus on the management of various different types of calls, which usually require the government of different situations together with a different agents' skill management. In such a scenario, the main objective is to find an efficient way to organize and manage a multi-task Call-Center. We will show how these kind of Call-Centers can efficiently be managed through a Dynamic Skill-Based Routing policy, instead of a Static Skill-Based Routing or even a call-processing policy using separate trunks-lines. After describing the typical structures of Call-Centers, we'll define a SD model, stating again how a simulation model can be useful in the management and sizing of a Call-Center. The paper will end with a case study where, through the simulation of different policies, it will be shown how the Dynamic Skill-Based Routing is the most efficient way to manage multi-call-types Call-Centers.

Securitization of future credits in a Public Administrations tax-collection process: a System Dynamics approach

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The distinctive role of a delocalized peripheral Public Administration is nowadays commonly acknowledged to be mostly consisting in providing services to its community of citizens. In order to accomplish this mission, the local administration has the evident and constant need of a certain cash amount, which should be basically ensured by incomes due to taxes imposed on citizens and that should hopefully require a regular and continuous cash flow. The last aspect represents a condition which usually is absolutely important and even necessary in order to properly and effectively schedule and manage the services that are then to be provided. Thus, in a complex and evolving legislative and administrative context such as the Italian one, this paper will try to state and show, by means of a system dynamics modelling approach, how a financial operation like the securitization of collectable credits performed by local PAs may constitute an efficient, effective and reliable tool in order to support proper and strategic decisions concerning the operation structuring as well as help reduce the collection delay, thus granting the organization with that sufficient liquidity which will be necessary to manage the actual services to the citizens and to program the provision of new ones on a larger time horizon.

An application of Saeed's environmental mitigation banking model: restoring coastal mangroves in Thailand

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In this paper we describe a system dynamics model developed to examine the feasibility of an environmental restoration banking system. Under this proposed system credits are issued by a governing authority to a restoration bank in return for undertaking environmental restorations. Users of the environmental resource are then required to purchase these restoration credits. A case study was developed for restoration of coastal

mangrove forests in Thailand. Model simulations show that the restoration banking system may be effective in restoring coastal mangroves and in rehabilitating the coastal shrimp farming industry which is dependent on environmental services provided by the mangrove stock.

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Comparing parameter estimation methods for service-based diffusion models

This paper compares methods for parameter estimation of diffusion models when seeking to extend these to service industry contexts from the traditional product focus. In the marketing science and economics literature, parameter estimation is dominated by econometric methods. This presents certain limitations as well as advantages compared to calibration in system dynamics modelling, which emphasises estimation of parameters by direct observation. But this poses a problem for industry or market-level diffusion models where deriving aggregate parameters in this way is impractical, especially for launches of new products or services which lack direct market knowledge. One solution is to use judgemental bootstrapping, implying estimating parameters from an expert's forecast time series. Models parameterised this way can then be used as a basis for simulated structural experiments of proposed market architectures. Some interim results from three service industry case studies are presented.

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CO2 Taxes or Tradable Quotas, Experimental Evidence of Biased Decision

Developed countries should find cost-effective ways to decrease Green House Gas (GHG) emissions to comply with their Kyoto Protocol targets by year 2012. The target can be achieved either by domestic emission reduction or by buying quotas in international markets. Policy makers have to choose between these policy options and decide to what extend and when to use them. In democratic countries these choices may be constrained by limited information and misperception among voters and politicians. Bias in the decisions may occur because the choice of policy is complicated by dynamics and uncertainty. To explore the possibility of misperceptions we perform a laboratory experiment where subjects are asked to make this difficult policy decision during 12 years preceding 2012. Biases in the implementation of the policies were found.

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Hierarchy or Network in Military Command Organizations? Preliminary Results from Experiments with the NCW Learning Lab

In environments that demand a high degree of flexibility together with rapid and accurate decision-making, network centric command structures have been promoted as "the" organizational solution to meet these demands. Network centric command structures, arguably, enhance the situation awareness and the understanding of the situation. The NCW

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(Network Centric Warfare) Learning Lab was developed to allow systematic, simultaneous experimental manipulation of structural and individual varibles, in order to observe the effects on dependent variables such as actual and perceived operational effectiveness. The Learning Lab was designed to particularly stimulate the dynamic aspects of decision making. Our preliminary results show that a network centric organization does not necessarily lead to higher perceived situation awareness or better understanding of the situation. Although our findings are in contrast to contemporary writings on the organization of military operations, we find them to make sense in light of basic theories about information processing in organizations.

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Model validity and testing in system dynamics: Two specific tools

System dynamics validation and analysis methods must be consistent with some unique defining properties of system dynamics. Very briefly, these properties stem from the fact that system dynamics models are causal descriptive models and they are designed for long term policy analysis and design objectives. One of the important results is the fact that system dynamics validity consists of two very different types: structural and behavioral. We present two different validity testing software developed at Boðaziçi University to assist with indirect structure testing (SiS) and behavior pattern testing (BTS II). SiS software does automatic dynamic pattern recognition and indirect structure testing. Our behavior pattern testing (BTS II) software estimates and compares the major dynamic pattern components of the simulated and actual dynamic behaviors. These pattern components are: the trends, periods of oscillations (single or multiple), phases of oscillations, the amplitudes (constant or time-varying), average values, variances (or higher order moments) and finally a single overall discrepancy measure (U). Another issue in dynamic simulation methodology is parameter calibration, assuming that the structure of simulation model constructed by the user is valid. SiS software also does automated parameter calibration with respect to a given (desired) dynamic pattern. This particular feature can also be used in policy analysis and improvement design.

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Fresh Insights into System Dynamics Methodology - Developing an abductive inference perspective

The relevance of abductive inference- the process of forming hypotheses- to System Dynamics (SD) methodology has been raised previously by Ryan (1996) and Barton (1999). This paper provides a further explication of this relevance. Specifically, it provides: • An introduction to the logic of abductive inference and its relevance to describing the management process. • An interpretation of the Events- Patterns of Events- Structure framework as an application of abductive inference. • A re-framing of the methodological debates between Forrester (1968) and Ansoff and Slevin (1968) • Implications for interpreting the role of the SD model within a complete learning structure.

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System Dynamics Economic Model with Fossil and Renewable Energy

Our objective is to foster the understanding of the economic impact on environment. We apply SD modelling methodology and conduct our simulation. We investigate major trends of global threats: deteriorating environment and depletion of non-renewable resources. We list the important and causal relationships among the levels and trace the feedback loop structures. In describing an economic and environmental model we focus on the relationship among income, pollution, and non-renewable. This paper yields insight into the possibilities for replacing non- renewable fossil fuels with more renewable ones. Next, we present the simulation runs of the model, conducted with the help of existing system dynamics modelling tools.

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Modeling U.S. Energy with Threshold 21

The United States is about to face years of major, interrelated policy issues. Energy transition, peak oil, and the threat of global warming, together with heightened fears of terrorism, environmental and social issues are largely crowded out of public dialogue. What is needed is an analytical tool that addresses these issues in an integrated and transparent way. The Threshold 21 (T21) model customized to the USA, is such a tool. The purpose of this study is to analyze T21-USA, by highlighting its flexibility and transparency. The analysis shows that T21-USA is a good tool for understanding and analyzing validity, effectiveness and outcomes of complex energy policies, such as the Advanced Energy Initiative - follow up of the State of the Union Address. Despite its complexity, T21-USA is transparent and a user-friendly interface makes it an intuitive instrument that can be used by a broad audience, ranging from students to policy makers.

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Innovation and the dynamics of capability accumulation in project-based organisations

Project-based organisations are increasingly becoming an important originator of innovations. Innovation in project-based organisations faces particular challenges due to issues of resource allocation, feedback and learning, corporate governance and client relationships. As innovation and capability accumulation in these organisations occurs largely in the context of project execution, the resources available for innovative work within projects, as well as the type and complexity of these projects, are a major influence on innovative performance. The strategies employed for the acquisition of new work represent a key lever in determining innovative outcomes. Drawing on the growing literature of project-based organisations in general, in particular innovation in project environments and contributions of scholars studying engineering design and project

management, this paper presents a conceptual approach - linking work acquisition, learning and innovation in project-based service organisations. This theory is expressed in diagrammatic form, providing a succinct representation of the complex relationships in addition to providing a starting point for an analysis of the challenges facing the management of project-based organisations, in particular, the vicious circles potentially impeding success. This analysis can help to elucidate findings from prior in-depth studies of a large number of engineering and design firms.

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The sustainability of museum growth: a system dynamics approach

Based on a review of existing literature in management and economics of arts and culture and on an extensive case study – the metropolitan museum district in Turin – this paper's objective is to show that museum growth is problematic in the long term through a system dynamics model. The classical loop – investments, growth, profitability, investment – encounters difficulties when dealing with public goods, characterized by high interconnections among museums and stakeholders within the same territory. The model simulation shows the structural characteristics of this sector that determines problems in term of survival; it can thus be understood as blending management and economic perspectives. Therefore, the search for sustainability should be addressed in controlling museum growth with a long time perspective and in supporting and developing new forms of cooperation among those organizations to decrease the "cost of growth.".

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Building "Dynamic" Balanced Scorecards To Enhance Strategy Design And Planning In Public Utilities

Increasing complexity and uncertainty of both business internal and external variables determines a growing need for prompt and accurate information. On this concern, in the last decade, there has been an increasing effort to provide public utilities with tools aimed to support decision makers in planning and control, by taking into account not only operational but also strategic issues. Among them, for instance, customer satisfaction, internal business process efficiency, business image, and bargaining power against other counterparts (e.g. the municipal administration). Quite often, however, such an effort has been oriented to generate a large volume of data, only focused on financial indicators and on a static view of the relevant system. This article shows how the use of Balanced Scorecards based on System Dynamics models can significantly improve the planning process in a strategic learning perspective. Empirical findings from a research project conducted in a municipal water company are analysed and discussed.

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Investigating how Intellectual Capital policies in a Telecom Call-Center affect Company Performance: a System Dynamics approach

In the present economy a growing number of businesses, and in particular those operating in the service industry, are often able to be successful in the market arena on the basis of continuous investments in intangibles assets, rather than only in tangible resources. Although intangibles assets may constitute the source of competitive advantage, businesses do not often understand their nature (Collins, 1996). In fact, it has been remarked in literature (Bontis, 2002) that managers do not know how organisation key-resources and related acquisition and depletion processes over time are likely to affect a success of a business strategy. This phenomenon may be due to a lack of methods and tools to use which would enable managers to analyse organisation intellectual capital stocks and organisational learning flows (Bontis, 2002). In order to overcome such difficulties, a conceptual framework has been developed and proposed to a Telecom company to investigate – through the lens of the System Dynamics methodology – how Intellectual Capital policies in a Call-Center are likely to affect the overall company performance. Main key-issues underlying the feedback structure and the System Dynamics model are discussed in the paper, and most significant outcomes from simulations are commented.

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Reducing Cross-Organization "Disconnects" in Large Space System Development Programs

This research uses a case study to explore leverage in reducing "disconnects" in baselines across multiple organizations in a large space system development program. Disconnects, latent differences in understanding that can negatively affect the program should they remain undetected or unresolved, can jeopardize program targets for cost, schedule, performance, and quality. In addition to case-study analysis, we constructed and analyzed a formal dynamic model of communication effectiveness across four organizations that rely on each other for requirements and deliverables. Findings to date refute common beliefs that disconnects result primarily from external stakeholders' requirements changes and that speeding up organizational processes will reduce disconnects. Instead, analyses suggest that the greatest leverage in reducing disconnects—and therefore mitigating program risks—lies in increasing expertise, improving communication clarity, and accelerating the pace of assessing impacts from changes in other organizations' understandings and actions—but not accelerating the pace of acting on those assessments.

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Conceptualising the main micro processes of technological change in the Swiss car fleet

For the benefit of a sustainable global development of energy consumption and its climatic impact the per-capita energy consumption in industrialised countries such as Switzerland shall be reduced, with the vision of not exceeding the actual global average of 2000 Watts. Reaching this goal affects all sectors, particularly the building and the transportation sector, as a main originator of CO2-emissions in Switzerland. In this sector, the most important effect is achieved by not only reducing consumption but also advancing alternative drive train technologies. The market penetration of these new technologies is to be modeled in order to learn more about the fundamental processes and derive strategies contributing to their successful introduction. An existing system dynamics model for the market penetration of passenger cars with new drive train technologies, focusing on natural gas vehicles (NGVs) as a first alternative to conventional gasoline and diesel cars, forms the basis for further work and is shortly described. Possible extensions, mainly in the customer sector, are discussed, as well as the introduction of different model layers for additional drive train technologies competing with each other. Finally a game theoretical approach to simulate the exogenous stakeholders shall link them closer to the system dynamics model.

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An improved model of the dynamic behavior of a zero-to-landfill strategy for consumer products

Zero-to-Landfill is a strategy that is gaining increasing attention throughout the world, driven by legal mandates and consumer demand. A product take-back process is required to ensure products that reach the end of their useful lives are reclaimed for reuse, remanufacturing, or recycling. We previously reported on a model of the material flows that exist within a take-back process. The results of dynamic simulations of a hypothesized take-back strategy enabled us to identify several policies and opportunities that, if executed, would minimize the material sent to landfills over the life cycle of a product. We proposed several extensions and modifications of our model that would improve the results and behavior of the simulations. In this paper, we present an improved model of a reverse logistics system for a consumer product. The impacts of closed-loop policies on material reclamation, product adoption rate, and product costs are investigated. We illustrate the relationships between the collection, processing, and reuse rates, and how the amount of material reused influences product costs, product sales, and, ultimately, corporate revenues and profits. A Zero-to-Landfill strategy is shown to have a significant potential to improve the triple bottom line – people, planet, and profit – of companies that adopt it.

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Strategic Enterprise Planning – Which Role does System Dynamics Play? A Survey

Within this paper predominant methods and tools that are widely used within corporate planning processes today are briefly described. Drawbacks of these techniques are highlighted supplemented by an attempt to explain why they are prevailing anyway. In the following the results of a study is presented. It covered several hundred articles and focused on the question how present is System Dynamics in strategic enterprise planning and related disciplines. Possible reasons for the result that has been detected are followed by recommendations what could be done in order to back the use of System Thinking and System Dynamics in the future.

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Expansion Economies

This paper develops a model that explains how and under what circumstances firms can realize expansion economies. In order to exploit economies of expansion while augmenting benefits, manufacturing firms tend to extend their economic activities to different locations, regions and countries. The level to which firms spread out in a region depends on the local demand. When such local demand is completely satisfied by the firm, it may decide to star business activities in other region. Firms' expansion process is limited by the size of the market whose boundary is the world demand. The growth of the firm through expansion economies depends on the scale of the different elements that form the basic business unit. In this paper it is also shown that expansion economies is a special case of increasing returns that cause neither dominant firm nor dominant technology.

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Management and Education of the Risk of Insider Threat (MERIT)

The Insider Threat Study, conducted by the U.S. Secret Service and Carnegie Mellon University's Software Engineering Institute CERT Program, analyzed insider cyber crimes across U.S. critical infrastructure sectors. The study indicates that management decisions related to organizational and employee performance sometimes yield unintended consequences magnifying risk of insider attack. Lack of tools for understanding insider threat, analyzing risk mitigation alternatives, and communicating results exacerbates the problem. The goal of Carnegie Mellon University's CyLab-funded MERIT (Management and Education of the Risk of Insider Threat) project is to develop such tools. MERIT uses system dynamics to model and analyze insider threats and produce interactive learning environments. These tools can be used by policy makers, security officers, information technology, human resources, and management to understand the problem and assess risk from insiders

based on simulations of policies, cultural, technical, and procedural factors. This paper describes the MERIT insider threat model and simulation results.

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The Retirement and Early Retirement Behaviour in Italy: A System Dynamics Approach

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The main aims of this study is underline that System Dynamics approach allows the building of a general framework in which psychological, economic, social, legal and organizational variables converge to describe the retirement behaviour and its main unintended consequences. It's emphasized that organizational commitment and psychological contract breach play a considerable role in the dynamics of retirement behaviour. In the first part of this paper, an analysis of main contributions in the retirement and early retirement fields is outlined. Further, the social, economical and legal approach to retirement behaviour is also briefly remarked. In the second part, retirement phenomenon, dynamics of the key-variables, problem issues, feedback analysis of adopted public policies, unintended consequences of public policies and policy design to remove these consequences are discussed. Results confirm that system archetypes are fundamental in the understanding the complex system that countersign retirement behaviour.

Combining System Dynamics and Asset-Liability Management in Pension Funds

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System dynamics may amplify A/LM (Asset/Liability Management) methodology capability to being risk oriented. Conceptual issues assigned to A/LM variables are described and a dynamic A/LM approach based on SD principles and risk factors in pension funds is examined. Risks must be defined in tangible operational terms. Pension Funds need to produce a high-income return to correspond to actuarial expectations and to pay benefits of different kinds. Its non-financial nature of the underlying assets and long-term liabilities dictates the nature of risk management processes and approaches that a pension fund must take. In a changing and complex environment, the wealth of the organization need a management of its investment assets with better tools than the static mean-variance analysis. ALM provides many advantages this way. Finally, since the decisions under uncertainties become complex specially because of the low comprehension of the long term best interests of the system as a whole, System dynamics methods may provide an holistic overview to the analysis of ALM results. The combination may improve the managers hability to explicit tacit knowledge, understand complexity and design better operating policies enhancing, this way, the discussions and learning about businesses strategies.

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System Dynamics Modeling Of All Element Innovation

The innovation management is the key activity for enterprises and it plays a significant role in pursuing core competence and sustainable profit. To achieve high performance, enterprises no longer merely rest on technology innovation but call for innovation synergy between both technology and non-technology elements including organization, strategy, culture, market, etc. The All Element Innovation (AEI), one aspect of TIM theory, aims at providing facilitating method for encouraging and regulating innovation of all synergic elements. In this paper, the system dynamics model of AEI is established to study the impact of the portfolio of innovation elements on enterprise's innovation performance. By simulation and policy analysis of the SD model, the interaction and dynamic characteristics of AEI is successfully worked out. The simulating results indicate that, for single element, culture and strategy influence the performance most significantly. In addition, the portfolio of culture and strategy, strategy and organization have the most profound effect on performance. Furthermore, we discover that the innovation performance with multiple coordinated elements is obviously higher than that with single or a few elements, thus confirming that heightened performance depends on synergic innovation process with multiple innovation elements involved.

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Knowledge, Dynamic Capabilities and Family Inertia in Family Business: A Computational Approach

The present research shows through computer simulations the dynamic positive interconnections among Knowledge, Capabilities, Dynamic Capabilities, Entrepreneurial Performance and Trans-generational Value in family business. In addition, interesting results and new insights will come out introducing Family Inertia in the model (as a function of Paternalism) which negatively influences the creation of capabilities and dynamic capabilities, with some exceptions. Keywords: Knowledge, Absorptive Capacity, Capabilities, Dynamic Capabilities, Trans-generational Value, Paternalism, Family Inertia, Family business.

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Organizational Culture and the Adoption of Virtual Practice Communities for Business Network Development

This paper examines the importance of organizational culture on the adoption of knowledge management practices in a government agency

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which goal is to help foster regional economic development. Virtual practice communities (VPCs) offer an interesting potential to help sustain knowledge management practices in business network organizations. The paper uses case studies from two VPCs sponsored by a Canadian Government agency to identify some the dynamics that may help sustain its success, and to provide a generic qualitative system dynamics model of the main influences that drive their adoption. The results presented in the paper are based on a series of interviews conducted with users, managers and leaders of VPCs. The qualitative data collected were analyzed are synthesized, and a dynamic hypothesis, represented in an influence diagram (ID), reflects the synthesis of the interview results that were analyzed using formal qualitative methods. From the ID, six systems archetypes were identified and stress some of the major influences involved in shaping the success or failure of a VPC.

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Strengthening Intellectual Property rights in Biotechnology Innovation: Learning from a System Dynamics Synthesis

This paper is concerned with the strengthening of the international intellectual property regime following the introduction of the TRIPS agreement. Three interrelated issues are examined in regards to the strengthening of patent protection in developing countries using a dynamic hypothesis, taking into account some of the key feedback loops at the core of the problem. These issues are: (1) the effect of patents on biotechnology access, (2) the effect of patents on the appropriateness of technology for developing countries, and (3) the effect of patents on the biotechnology embedded in capital, or on the capability to innovate/learn. The results of the analysis show that the introduction of TRIPS may generate unintended side-effects, and the strengthening of patent protection, while perhaps a necessary condition to help foster biotechnology innovation in developing countries, may not be sufficient.

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The Possible Future Development of a Market for PEM Fuel Cell Road Vehicles – A SD Based Analysis within an EC Funded Project

Hydrogen fuel cells are increasingly seen as the propulsion technology of the future for road transport. However, despite the potential of this technology to reduce the environmental impact of road transport and to improve energy efficiency, both technical and economic barriers need to be overcome for these technologies to be successfully introduced in mass markets. At Imperial College we are currently undertaking an analysis of the possible future dynamics of the PEM fuel cell market for road transport in Europe. This study is part of an EC-funded, Integrated Project involving 18 partners from both industry and academia; this allows extensive interaction with key market players of particular relevance to the dynamics under study. This paper presents results of

work in progress, which involves the development and use of a simulation model as well as a dedicated group learning session with project partners.

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Maintenance Policies for Capacity Constrained production Systems

This paper considers the maintenance policies for a production system constrained by its production rate and buffer capacity to cope with unexpected failures and to deal with variability of demand and production lead times. Using a system dynamics model, we characterize, simulate and compare results obtained by applying several maintenance policies. We compare and discuss the benefits of different optimization criteria in the maintenance decision making process for a production system with constrained production rate and buffer capacity.

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A structured approach for the assessment of system availability and reliability using continuous time Monte Carlo simulation

Modern availability and/or reliability studies of industrial systems have to take into account many considerations related to complexity (different abstraction levels; vast array of units, components, etc); wide range of failure modes; arbitrary failure and repair distributions; functional and/or technical dependencies among components; Data not available, etc. Taking into account these considerations, the opportunity to carry out system availability assessments through analytical models, will be many times very restrictive. A general approach to this problem is based in Monte Carlo (stochastic) simulation. The simulation of the system's life process will be carried out in the computer, and estimates will be made for the desired measures of performance. The simulation will be then treated as a series of real experiments, and statistical inference will then be used to estimate confidence intervals for the performance metrics. In this paper we will use the continuous time simulation technique to model and assess the availability and reliability of a system.

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Difficulties Understanding System Dynamics: A Challenge to Researchers, Educators, and Citizens

This study examines people's comprehension of stock and flow systems, a class of problem that, despite its ubiquity and importance, has been mostly overlooked by management researchers. Stock and flow (SF) systems involve resources that accumulate their inflows less their outflows. Arising in domains from accounting to zoology, examples of stocks include inventory, debt, non-renewable fuels, and pollution. In a series of six experiments we demonstrate that highly educated people have great difficulty understanding even the simplest SF systems. We

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argue that the difficulty is related to how people represent these systems cognitively, not inability to interpret graphs or text, prior contextual knowledge, motivation, or cognitive capacity. We find that people's inability to properly understand the accumulation or depletion of a stock is a robust error, and that at least part of the difficulty arises from people's inability to properly represent the basic principles governing accumulation. We argue that the SF class of problems may be inherently difficult, much like probabilistic judgments. Given the ubiquity of SF systems, and their importance in making informed judgments, we call for further research to understand how to improve people's intuitive ability to understand processes of accumulation.

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Efficiency and Dynamics of the Organizations: Innovation and Decline

The organization can be a potential resource for encouraging innovation in a company. In its turn, innovation changes the organization. In this paper we will endeavour to study and understand the network of mutual determination of the couple which we will call: “Organization - innovating Process”. We will therefore analyze the organizational elements which increase creative effervescence. System dynamics enables us to understand, over periods of time, how the process of innovation is created as well as how it can disappear. Indeed, it is in the duration and lifecycle of the organization that one can observe the collaborative forces which create the conditions for innovation. We wish to show that the changes of an organization's state and the properties which result from this exacerbate or on the contrary inhibit innovation. Innovation is a process which begins with the identification and acquisition of knowledge and ends with transferring and implementing this knowledge into organizational initiatives. We will highlight the principal feedback loops and propose a model showing the behaviours and the counter-intuitive effects resulting from interactions between variables. We based our research on a study carried out in a company. Our model can be used to teach the dynamics of organizational innovation.

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A System Dynamics Model for Economic Planning in Sarawak

This paper describes the outcome of a research project undertaken for the government of the State of Sarawak in E. Malaysia. A system dynamics model was constructed so as to inform the State’s future economic and social planning to 2020. Positive engagement with State government officials at the highest levels was a feature of the successful completion of the work. A flexible policy evaluation tool for use in their macro-economic planning is now available to be used by those officers who were exposed to several training sessions in system dynamics modelling.

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Long-Term Care And Confinement: A Projection For The Italian Population

A multi state model was develop to predict the number of Italian people who are going to be confined for the next 50 years. Confinement relates to the most severe disability state and represents the bulk of long-term care need. Prevalence rate data, transition rate data and trends data relating to disabilities were collected. The Italian National Institute of Statistics is the source for prevalence rate data and future trends of disability. Transition rates are derived from prevalence rates. Since there are no clear patterns of life expectancy and disability trends, the results are described using two extreme case scenarios as well as a scenario without any trend assumptions.

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Aggregated and Disaggregated Modeling Approaches to Multiple Agent Dynamics

This research deals with alternative modeling approaches to multiple agent dynamics. Models of a supply chain system are constructed to make comparisons about the capabilities of aggregated (System Dynamics) and disaggregated (Agent-Based) modeling approaches, based on a query to answer questions such as "Can aggregated, macro-level modeling capture the dynamics of micro-level, agent-based modeling? In what specific cases?" Effects of several factors, including inventory positions, price, shadow orders, loyalty, safety stocks, and ordering policies are analyzed. It is shown that there are factors, effects of which can be captured by System Dynamics at an aggregate level; however it is also observed that System Dynamics may miss the dynamics at more detailed level resulting from the emerging heterogeneity among individual agent behaviors in these cases. There are also cases where System Dynamics cannot capture the dynamics generated by ABM, even at an aggregate level. Regarding the supply chain dynamics, it is shown that when agents try to act 'rationally', emergent system behavior may become destructive. Loyalty and reliable safety stocks are proposed as strategies against oscillations in the supply chain.

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Mental Models and Dynamic Decision Making: An Experimental Approach for Testing System Methodologies

Systems thinking and system dynamics are widely used methodologies for studying and managing complex systems. A two-way interaction between a person's mental model and an explicit representation of that model leads to an improved understanding of the system. However, the effect of these techniques on a person's dynamic decision-making abilities is yet not fully known. To explore this relationship, an experimental study was conducted. Results show that most participants initially had poor understanding of basic dynamic situations. However,

the completeness and accuracy of their mental models improved considerably with system interventions. Specifically participants' ability to discern between stocks and flows, identify causal relationships and feedback improved by around 27% after a systems thinking intervention. These abilities further increased by around 4% after participants underwent a system dynamics intervention. Interestingly, in complex tasks that required an in-depth analysis, systems thinking hardly made any positive effect on participants' decision-making. However, for the same situation, participants' mental models improved by 8-50% after system dynamics intervention. The results of this study confirm with the results of some of the previous studies done in this area and provide a deeper insight on the impact of systems thinking and system dynamics on dynamic decision-making.

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"I'm not hoarding, I'm just stocking up before the hoarders get here"

Phantom orders arise in real supply chains when suppliers are unable to fill orders on time. Customers respond to product shortages by increasing orders and ordering through different channels in an attempt to gain a larger share of the shrinking production pie. Suppliers, often unaware of the underlying demand, respond by increasing output. As allocations increase customers cancel their phantom orders, leaving suppliers and distributors with large surplus stocks. As the title indicates, such behavior can be rational, as multiple customers compete for limited supply. Here we examine the behavior of subjects in the beer distribution game for evidence of phantom ordering. Phantom ordering is never a rational response to shortage in the experiment because there is only one customer for each supplier, no randomness, no production capacity limit, and, in this implementation, customer demand is constant and publicly announced to all players. Yet we find that a significant minority exhibits phantom ordering. We speculate that the urge to hoard evolved early in human history as a locally rational response to scarce resources, and that the brain center responsible for the hoarding response is likely to be distinct from the loci of economic decision making.

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Preventing desertification and achieving sustainability in the Black Lands, Kalmykia, Russia: a system analysis approach

Black Lands is an agricultural area in the Republic of Kalmykia (Russia). Previous agricultural practices under administrative planning economy during 1960s-1980s resulted in land desertification, loss of agricultural productivity, and lowered biodiversity in the area. Saiga antelope as an element of biodiversity in the area has been affected by land use management and poaching. Transition to market economy followed by livestock starvation due to fodder shortages, had a positive impact on Black Lands pastures and saiga population. It resulted in revival of livestock numbers while agricultural practices remained unchanged and poaching intensified. The aim of the paper is to investigate existing agricultural practices and trends to forecast the region's future under different scenarios using systems analysis methods. The research showed

that the desire to maximize economic benefits leads to overgrazing and pastures destruction and hence, loss of agricultural productivity. Sustainability can be achieved by changed land uses; limiting livestock population and preserving pastures, implementing effective mechanisms against saiga poaching and providing the local population with diverse economic activities to contribute to their incomes.

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A Comparison of Petri Net and System Dynamics Approaches for Modelling Dynamic Feedback Systems

Petri nets are a valuable tool that can be used to simulate workflow systems. They are based on a state-transition approach, and in common with discrete event simulation, events can be scheduled to fire at different time intervals. This is in contrast to the stock and flow approach of System Dynamics, where workflows are aggregated and state transitions modelled continuously through sets of integral equations. This paper continues a theme explored at the Boston 2005 conference, where a paper was presented that identified a common simulation problem, and presented solutions using both discrete event simulation and system dynamics. The benefit of this approach is that it can provide modellers from different methodological worldviews insights into how common problems may be addressed. The problem approached here is a one-actor model of the Beer Game. Two models are developed, detailed experimentation is performed, and overall results and conclusions presented.

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System Dynamics Model of the Croatia with Inbuilt War Situation 1953 - 2033

The Computer Simulation Model of the Socio-Economic and Ecological System of the "CROATIA"-SEESC had been developed in accordance with the System Dynamics Approach. It is a continuous model and at the same time discrete digital model because it is presented as a system of non-linear differential equations and it is presented as a system of difference equations (System Dynamics DYNAMO-software program-package) and its “DT” (length of intervening time = computation interval) is chosen in full accordance with the Sampling Theorem (Shannon and Koteljnikov). In this paper the authors have presented the principles of the application possibilities of the System Dynamics Modeling Approach on the Socio-Economical and Ecological Systems of Croatia. Further, they have conducted elementary observations on the Socio-Economic and Ecological Systems of CROATIA-SEESC, their four regional parts (CMZSR, CSOSR, CNWACRSR and CDACSR), the Space and Environment Sector-SES of the CDACSR, and the high aggregated structural models of the SES, ecological model of the CDACSR, and rudimentary global model of the SEESC. The developed model covers period from years 1953 to 2033, with inbuilt war situation (1990-1995).

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Simulation Modelling of Marinas and Heuristic Optimisation of Business in Relation to Investments in Sports Objects

System dynamics simulation modelling of marinas in relation to investments in sports objects will enable rise of the quality of the total offer and competitive forces of the observed system, and at the end growing satisfaction of tourists. The system of marinas (LNT) has all the characteristics of a complex organisation and business system, for which dynamic modelling efficient methods of simulation techniques have to be used. One of the relatively recent, and particularly exposed and practically proved scientific methods is system dynamics simulation modelling which was developed by the Professor Forrester in the famous world scientific centre of the development of management science - The Sloan School of Management (MIT). This model is developed for the practical training of marine management students. In this paper, the business system of marinas (LNT) will be determined through a global model of integral nautical and tourist service(from berthing service as a basic service to all other additional services). The subsystem of investments in new capacities, like sports and additional capacities will be determined by exogenous variable VINK – value of investments in new capacities.

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SD for Assessing the diffusion of wind power in Latin America: The Colombian case

Given the importance of renewable energy for mitigating Global Warming, without hampering development, this paper explores the feasibility of wind farms in developing economies. The analysis is based on an SD model of electricity markets that represent the behaviour of the agents involved and their decision to invest according to market and/or regulatory incentives - the likely expansion of wind farms depend on such incentives. This research is carried out in the context of the Colombian electricity market and accordingly we take into account likely synergies that may favour the potential exploitation of wind farms in this country. This paper examines how soft regulation may efficiently promote the penetration of wind farms in Colombia.

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Environmental Conflicts, Stakeholders and a Shared Mental Model

Environmental conflict management involves the management of multiple stakeholders with conflicting stakes. In this paper, an attempt is made to develop a shared mental model of stakeholders in an environmental conflict. The Transmission Gully project, a large-scale transport infrastructure project in the Wellington region of New Zealand is used as a case study. Selected stakeholders of this project tried to

generate this shared model, in the form of a causal loop diagram. This model is analysed qualitatively to provide different insights into potential system behaviours.

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Modeling the Effects of the Single-Hull Tanker Phase-out on the World Oil Tanker Market

The dynamics of the global oil tanker market has long been studied by practitioners of System Dynamics. This paper does not seek to repeat what has been done, but rather to focus on an aspect which has recently taken on greater importance: the phase-out of single-hull tankers by 2010, and double-bottomed or double-sided (but not true double-hulled) tankers by 2015. In particular, questions of interest are: might the single-hull ban lead to extremely tight supply through 2010; and is it likely that the industry will overshoot the number of newbuilds necessary, leading to a crash in spot rates after 2010? Preliminary results indicate that the answer is yes to both questions.

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Lessons learned from unsuccessful modeling interventions

This paper report several related failures of modeling interventions. Atrivé, an organizational consulting company, set out to adapt the canonical housing association model, named ITS, (Vennix, 1996) for the specific circumstances of its clients. The ITS adaptation process, however demonstrated rather annoying dynamics and had finally to be terminated due to negative business results. This paper provides a background on the relevance of failure case studies and ventures into the symptoms and warning signs. We reflect on a system thinking intervention within the company to learn from these experiences and improve business strategy and project the problems encountered onto the core set of archetypes. We conclude by summarizing several known and one possibly new factor in modeling failure and pose several questions for further research.

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Managing PM10 in the Las Vegas Valley

This poster describes a model for managing particulate matter (PM10) in the Las Vegas Valley, currently categorized as a serious non-attainment area for PM10 by the U.S. Environmental Protection Agency (EPA). The project client, the Department of Air Quality and Environmental Management (DAQEM), must provide a predictive model to the EPA as part of its plan to mitigate particulate emissions and wanted to utilize system dynamics for improving current methods. The model uses parts of Solomon's (1994) framework for regional air quality planning and management, including: sources of emissions, meteorology and transport, and removal processes. It is designed to meet the requirements of the EPA, identify policy levers for effectively reducing emissions, and allow

for future addition of real-world management components such as the permitting system. This poster presents the structure of the working model, its results, and discusses its implications on managing PM10 in Las Vegas.

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The Dynamics of Innovation and Product Platform Development: A Case Study in Hybrid Electric Vehicles

ABSTRACT This paper explores the topics of innovation dynamics and investment choices that exist in subsystem design architectures of complex product developments. A particular theme in the innovation literature is captured and extended. This refers to the process of knowledge development regarding technology intersections within product developments that can sustain product innovation. This is fulfilled in this research through a composition of analytical tools that are used to match the case study environment. In this regard a unique variety of modeling techniques are sequenced to complement the problems encountered and support the outcome of technical and economic decision criteria. The case study presented here is at the forefront of economic and environmental concern - the evolution of Hybrid ElectricVehicles, HEV, efficiency. This paper outlines an innovative and analytical decision approach that is at the core of HEV evolution.

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Modelling the Liberalisation of Market Access

Differences regarding the liberalization of agricultural markets are a central issue in the current Doha-round of WTO negotiations. The positions of the individual countries and country groups differ significantly as far as market access is concerned. The positions can be explained by the existing levels of market support and thus by potential agricultural income losses as a consequence of market liberalization. The purpose of this paper is to analyze the dynamic impacts of different adjustment steps in market access and the resulting interactions between the agricultural markets. Adjustment steps can consist in an expansion of tariff quotas and in a reduction of import tariffs. Our simulations show that price development and thus the development of the revenue from agricultural products depend on several factors. In addition to domestic supply and demand the temporal design of market liberalisation is a key influencing factor.

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Participatory Modeling for Adaptive Management: Reports from the Field

Participatory environmental modeling is an adaptive management tool which natural resource managers, those dependent upon natural resources, property owners, and government agencies may use to help

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them understand the complexities of ecosystem management. Models have been used for sage-grouse, bear and fishery management, estuary systems and watersheds. These models share adaptive management theory, but differ on many other aspects such as the number of stakeholders and the degree to which they are involved. There can be many levels of involvement that are layered in a representative fashion with the modelers and intensely involved participants at the core. Varying physical, social and economic boundaries and the availability of data affect the time spent on different facets of the process. Finally, the intended use of the model may differ. Some processes are designed around group learning while others create tools which will assist with management decisions.

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Simulating Carbon Markets in the Western US and Canada

This paper describes an interdisciplinary approach to computer modeling of large-scale power systems. System dynamics is used to represent the the feedback relationships which govern the long-term evolution of the system, while engineering methods are used to calculate the short-term prices and power flows in the transmission network. This approach has been implemented in a model of the WECC, the Western Electricity Coordinating Council. The paper uses the WECC model to simulate the impact of the carbon allowances market envsioned by the Climate Stewardship Act of 2003. The simulations indicate that the western electricity system could achieve dramatic reductions in carbon emissions over the next two decades. The preliminary results indicate that the large reduction could be achieved with only half the increase in retail electricity rates that have been predicted for the nation as a whole.

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Revisiting Classic Energy Models for Evolutionary System Insights

This paper reports the results of a comparison of quantitative and qualitative approaches to systems analysis. The primary goal of the investigation was to test a heuristic for qualitative analysis previously proposed by the author that is intended to improve recognition of potential sources of failure for models used for forecasting. A series of papers published by John Sterman, George Richardson, and Pål Davidsen in the mid- to late-1980s examining resource estimation methods and the petroleum lifecycle were selected for analysis based on their completeness and perceived high quality of the models – both quantitative and qualitative. The quantitative results presented in those papers are compared to published data and some potential sources of deviation are identified. The paper then presents an analysis of the qualitative models contained in the papers, highlighting the differences in the nature of insights available from the qualitative and quantitative analyses and illustrating how this expanded logic for qualitative analysis may contribute to the formulation and bounding process for predictive system dynamic models.

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Assessing the impact of energization in the Colombian Southwest: a case of application using System Dynamics

This paper focuses on the problem of rural energization in isolated regions in Colombia (Not interconnected zones – NIS). Using the Sustainable Livelihood approach we assess the situation of the isolated communities before and after energization. Systems dynamics is used for simulating and evaluating energy policies. We apply our approach to the municipality of Jambaló in the Cauca department, Colombia.

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MindLab: A Flexible Framework for Training Decision-Making

Decision makers are often faced with insufficient and incomplete information, yet are forced to make decisions on this basis. The result may often be unintended consequences or situations where too few or too many resources have been allocated to solve the problem. Practicing decision making is often realised through live-exercises, which tend to be extremely expensive, or by using table-top games, providing a much lesser amount of realism to the game. MindLab allows for more sophisticated training arenas to a relatively low cost. The idea is to create a simulation model general enough to accommodate different decision making scenarios, accompanied by relatively rich user interfaces and an experiment setting that gives the game a high level of realism. This paper looks into how the MindLab architecture functions, as well as presenting two different simulation models with accompanied user interfaces that are currently being used with MindLab.

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Virtual Software Project Dynamics - The Human Resource Management Sector

Virtual teams are fast becoming the norm in organizations and strategies are needed to deal with the new challenges that they create. Software Project Dynamics is a field of research that uses system dynamics simulation to explore software engineering issues. The objective of this research effort was to enhance systematically the understanding of virtual software engineering by using the system dynamics methodology and existing software project dynamic models. To accomplish the research objective, the following tasks were accomplished: First, an extensive literature review was done. Second, a Software Project Dynamics model was reproduced. Third, the model was used as an experimentation vehicle. This paper suggests that system dynamics is a viable tool in the exploration of virtual software engineering challenges. A new field of research is recommended to deal with additional challenges of virtual software project teams by using system dynamics with the proposed name: Virtual Software Project Dynamics.

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Towards a System Dynamics Framework for Understanding Interactions of Head- and Tail-Users in Irrigation Systems in Kyrgyzstan

In irrigation systems over-abstraction of water and/or neglected maintenance are common problems faced by their users. For a generalized system with head- and tail-users, which interact through water abstraction and maintenance, a feedback structure is presented. It builds on causal relationships derived from theoretical work on collective action and irrigation. The concept of the model can be looked upon as a general formulation of two mutually – but asymmetrically – dependent groups of users with regard to a common resource. Main objective of the study is to provide a systems framework allowing for a deeper understanding of the social and institutional nature of irrigation problems. It is embedded in transdisciplinary research in Kyrgyzstan and Kenya aimed at developing strategies for a sustainable future in semi-arid rural areas.

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A simulation model for the generation activity in the new Spanish liberalized electricity industry

Liberalization of the Spanish electricity industry supposes important changes in the decision of generation investment, as in other countries, by means of the elimination of the binding planning in such a decision. However, the volatility of the electricity spot prices united to the regulatory uncertainty of all liberalizing processes and the low elasticity of demand can suppose the formation of boom and bust cycles in the decision of investment in new capacity. The elaboration of a simulation model for the Spanish case establishes the presence of such cycles where the power guarantee does not resolve the problem.

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Developing Flexible Expertise in Senior Executives

Modern, flatter and leaner organizations are facing a shortage of human capital in the senior executive ranks. The solution to this succession problem requires new methods for accelerating the development of the knowledge and skills required for senior executive roles. Building on the research evidence from the study of expertise we outline a construct of flexible expertise and synergistic leadership skills required to convert that

expertise into effective action in senior executive roles. We then present a research program and agenda for the accelerated development of flexible expertise and synergistic leadership skills using microworld simulations, coaching and roles plays.

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Acceptance Dynamics

We investigate irreversible acceptance dynamics, leading to phenomena typical for paradigm change not described by widely used reversible and static behavioral models, e.g., multistability, hysteresis, critical parameter values (tipping points), irreversible state changes. Based on a recycling model, we explain these phenomena and develop a simple, generic mathematical model describing the basic traits of acceptance dynamics. Analytical investigations and numerical experiments with this generic model show reproduction of the above mentioned phenomena. In addition, the generic model shows the interplay between internal and external forces. The relation of their time constants is shown to play a crucial role, leading to reversible elasticity dynamics or irreversible acceptance dynamics. Critical parameter values (tipping points) separating elasticity dynamics from acceptance dynamics can be deduced from the generic model. We show that some simplifications applied to the waste recycling model lead to the generic acceptance model. Further, the acceptance model is shown to comprise also the well-known Bass model to describe market diffusion of new products. Finally, we discuss benefits of the generic model, its possible extensions to include additional phenomena, and its research implications.

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Hard-disk makers' overshoot rooted in disruptive innovation

Model analysis in system dynamics (SD) entails articulating exactly how the structure of circular, feedback relations among variables in a system determines its performance through time. This article combines disruptive innovation (DI) theory with SD to show the use and benefits of model analysis with the pathway participation metric (PPM), implemented in the Digest® software. The model replicates the hard-disk makers' overshoot and collapse dynamics that DI allegedly caused. Multiple insights emerge from the dynamics the model computes. Model analysis shows that, over five distinct time phases, four different feedback loops become most prominent in generating the hard-disk makers' population dynamics from 1973 to 1993. And Digest® helps detect exactly how changes in loop polarity and prominence determine system performance.

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A Systems Theory of Small-Cell Lung Cancer

Cancer is a problem that has long been wrought over by philosopher and biologist alike. It provides a tremendous insight into the diversity of complex phenomena, into the ontogeny of order, into the deepest deterministic principles of life itself. Here we try to sketch dynamically the emergence of such a metastatic and invasive process, tying together

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chemical, molecular, and physiological insights to more clearly define the problem. We follow the progression of small-cell lung cancer in a population of brachial lung cells – tracing the molecular, cellular, and systems etiology of this complex disease.

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Eigenvalue and Eigenvector Analysis of Linear Dynamic Systems

Formal model analysis remains an important and challenging area in system dynamics. This paper proposes a method to incorporate eigenvectors to the now more common eigenvalue analysis of dynamic models. We provide a description of the application of the method to a linear system example.

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Coming to Terms with Traffic Congestion

Traffic congestion is a significant problem for modern society, but it is a necessary evil. Congestion is the principal mechanism to resolve the surplus demand for road space during peak traffic areas. There is universal agreement that traffic from privately owned vehicles (POVs) will greatly increase in most parts of the world in the next 5-15 years. Acknowledging that traffic congestion will continue to be society's main solution to the competition for scarce road space, this paper proposes additional teleworking facilities with a door-to-door shuttle services with mini-offices. Whether stuck in traffic or not, time spent driving in POVs is unproductive, whereas near office conditions provided in trains, ferries and, nowadays, also in planes make it possible for passengers to stay productive . Teleworking in a door-to-door shuttle service with mini-offices would increase the attractiveness of public transit services in some large cities and, possibly, in larger quasi-urban areas in heavily populated countries. Such condition might provide leverage to deal with heavy traffic, especially traffic congestion. We suggest niches for an experimental transition to door-to-door shuttle services with mini-offices. We propose further systemic studies to find out what kind of industrial synergies would arise and how large society's leverage to deal with heavy traffic could be.

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Development of a Group Model Building Framework

Group model building is nascent the latest years. However, only few educational institutions offer professional education and research in the field. Furthermore, detailed empirical literature about group model building is rather rare. Hence, this paper will serve three purposes connected to group model building. First, it will document and critically reflect upon a group model session and derive lessons learned. Second, it will create a comprehensive group model building framework based on

existing streams of research. The result is a framework that includes context and stakeholder analysis as basic preparation tools for a group model building project. In the more modeling session oriented stages, the approaches of Vennix and Andersen et al. will be integrated. And thirdly, it will apply the developed framework to a current research project in which the diffusion of energy-efficient innovations will be modeled. Further research will concentrate on validation and elaboration of the developed framework.

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Multi-Perspective Reflections about Interactive Learning Environments

An Interactive Learning Environment (ILE) is a tool to convey learning effects about dynamic and complex systems. Information can be packaged and delivered to assigned persons. Several pedagogical objectives are achievable: Teaching the capability to operate dynamic systems, awareness about the effective delays, focusing on the importance of feedback loops and their strengths, and familiarize the learner with the concept of nonlinearities. As an instance, the flight simulator 'Managing a Consulting Company' puts each of two participant groups in the role of a Consulting Company's management board. The ILE is created as a network simulation, which creates a dynamic learning environment and enables greater learning effects than normal single simulation models. By experiencing the simulation, the participants will obtain knowledge about the dynamic resource perspective of strategic management. The simulator, particularly, provides learning effects about management of intangibles and dynamic decision making. In order to facilitate a successful ILE-training session, it is beneficial to reflect about several perspectives connected to the development of ILEs. This is the goal of the paper. It concludes with a heuristics about the different perspectives of an ILE-session.

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Diffusion Dynamics of Energy-Efficient Innovations in the Residential Building Environment

The overall target of the Swiss Energy Policy is to reduce CO2-emissions and thereby to achieve the vision of an energy-efficient '2000 Watt per Capita Society'. A major instrument to contribute to the vision in the residential building sector is standards about energy-efficient building designs. However, new residual houses according to the energy-efficiency standard are not as often constructed as they ought to be. This short-term decision has a long-term consequence. In this paper, a preliminary System Dynamics model about the system 'residential building environment' will be presented with the purpose to explain the development of key variables of the building environment system. The analysis of possible policies put forward that a sound understanding of the decision process of potential building owners is necessary to create a beneficial system design which foster the diffusion of energy-efficient building designs. Furthermore, the paper should enable discussions about the model and methodological issues of the model creation process.

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System Dynamics Projects That Failed to Make an Impact

The purpose of the paper is to discuss the phenomenon why some system dynamics projects fail to generate substantial impact in organizations—despite the fact that they are based on an apparently valid system dynamics model and are conducted by experts in the field. The approach followed in the paper is a conceptual discussion, extended by a few short case studies. Findings are that the quality of the model and the expertise of the modeler are necessary, but not sufficient requirements for organizational impact. Further research should concentrate on the detailed analysis of additional requirements. Practical implications are an increased embedding of system dynamics projects in organizational intervention architectures. The originality of the paper lies in its focus and discussion of failed projects that are invaluable sources for insight generation.

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Feedback Loop Dominance Analysis of Two Tree Mortality Models

Two hypotheses on how tree mortality progresses are proposed in the literature: Manion's gradual decline and Bossel's sudden death hypotheses. Bossel already formulated a mechanism in his model, BAUMTOD, as the cause of sudden death phenomena. His model, however, cannot be used to generate a causal understanding to Manion's hypothesis. Therefore, a causal mechanism for the gradual decline pattern is suggested and incorporated in BAUMTOD; the modified model is called BAUMTOD-M. The suggested mechanism concerns the internal imbalance of respiration demand and available photosynthate supply. The eigenvalue elasticity analysis (EEA) is employed to study the likely structural causes behind tree mortality according to the two hypotheses. The analyses of both models suggest that, in stress-free conditions, a tree functions as an integrated organism. The analyses further suggest that the inability to supply respiration demand plays a crucial role at the onset of mortality. Differences in assumed mechanisms regarding the impact of this inability cause different paths to mortality in each model. This may mean either 1) Bossel's hypothesis is a special case of Manion's hypothesis or 2) there are truly different mechanisms at work in various observed mortality cases. More data and research is needed to clarify these points.

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Using Dynamic Stories to Communicate Information Security

Safety reporting systems, e.g. Air Safety Reporting Systems, are extremely efficient components of well-functioning safety schemes. A Cyber Security Reporting System is badly needed, but good information security data is very difficult to gather and many barriers prevent making existing data available for scientific purposes. In the scarcity of real-cases, we argue that 'Dynamic Stories', i.e. the various narratives that can be derived from system dynamics models of the existing system dynamics studies of information security might help establish a Virtual Information Security Reporting System. We do have an interesting opportunity in our running study of information security risks in the transition to eOperations in the offshore oil & gas sector. Given the importance of security for eOperations and the huge stakes involved, it seems that an umbrella organization such as the Norwegian Oil Industry Association is a potential adopter of a Virtual Information Security Reporting System. Our paper formulates issues that need to be solved in order make our vision of such reporting system a tangible prospect.

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A Generic Model of Contagious Disease and Its Application to Human-to-Human Transmission of Avian Influenza

Modeling contagious diseases has taken on greater importance over the past several years as diseases such as SARS and avian influenza have raised concern about worldwide pandemics. Most models developed to consider projected outbreaks have been specific to a single disease. This paper describes a generic System Dynamics contagious disease model and its application to human-to-human transmission of a mutant version of avian influenza. The model offers the option of calculating rates of new infections over time based either on a fixed "reproductive number" that is traditional in contagious disease models or on contact rates for different sub-populations and likelihood of transmission per contact. The paper reports on results with various types of interventions. These results suggest the potential importance of contact tracing, limited quarantine, and targeted vaccination strategies as methods for controlling outbreaks, especially when vaccine supplies may initially be limited and the efficacy of anti-viral drugs uncertain.

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Expanding Health Coverage and Access for the Uninsured: A Model of Common Factors in the Experience of Several States

Why is health reform so difficult to achieve in the US? When it does succeed, what factors contribute to its success? This paper extends a causal model presented last year to include political and other factors that help to answer these questions. The paper examines the experience of

several states in the US as they have struggled with a key aspect of health reform, extending insurance coverage to children, families, and other groups that are uninsured. . It also draws from other models that have been applied to understanding political and social change. The causal analysis that is presented emphasizes the importance of making policy choices in shaping proposed reforms that fit within a "window of opportunity" presented by the state's political and economic environment. The paper concludes by suggesting that expanding access must be viewed as an ongoing process in which early successes create opportunities to benefit additional people.

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Dynamic model for earthquake disaster prevention system: a case study of Taichung City, Taiwan

On 21 September 1999 at 1:47 am, an earthquake measuring 7.3 on the Richter scale struck central Taiwan, causing serious damage and loss of lives. As of February 2006, only 70% of the reestablishment work has been completed. With rapid advances in urban development, the destruction incurred by earthquake disasters increases both in extent and severity. With the aim to minimize loss in human lives and properties caused by natural disasters, this study probes into the urban disaster prevention mechanism, examines the problems encountered in disaster prevention and strategies for prevention. A system dynamics model is established to simulate changes in the disaster prevention system on the basis of related statistics and survey data of September 21 Earthquake. Strategies for urban planning, development and management are suggested from the perspective of disaster prevention. The simulation analysis can offer valuable insight to policy-makers for assessing and deciding on the most feasible and effective strategies to be implemented.

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System Dynamics Modeling and Simulation of Distributed Generation for the Analysis of a Future Energy Supply

In this paper an application of the System Dynamics approach in the field of energy supply is presented. Decentralized energy supply is introduced as a new energy system with a high potential for meeting ecological requirements and sustainability targets. System Dynamics models of one power supply unit (PSU) and of the decentralized energy supply (New Energy System Model) are described. The electrical and thermal power flow and the power conversion processes represent the basis for the stock-and-flow diagrams. At any time and for every sub process of the overall system the precise power and energy state can become certain and comprehended for the user. With examples some results of simulation are represented. Investigations of technical and ecological potential of decentralized energy supply systems are the primary objective of the models. The models are also used for education purposes for the elucidation of energetic supply processes with different power station technologies.

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Obesity Population Dynamics: Exploring Historical Growth and Plausible Futures in the U.S.

A system dynamics simulation model was developed for understanding trends in obesity in the United States. Data on population body weight from 1971-2002 were combined with information from nutritional science and demography into a single analytic environment for conducting simulated policy experiments. Interventions among school-aged youth and others were simulated to learn how effective new interventions would have to be to alter obesity trends; which population subsets ought to be targeted; and how long it takes for those actions to generate visible effects. One finding is that an inflection point in the growth of overweight and obesity prevalences probably occurred during the 1990s. Another is that new interventions to assure caloric balance among school-age children—even if very effective—would likely have only a relatively small impact on the problem of adult obesity. More comprehensive efforts at all ages are needed to avoid the high costs and heavy burden of disease due to adult obesity.

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Comparing the Effectiveness of System Dynamics with Traditional Methods of Learning about Wetland Ecosystems

This poster reports on the preliminary results of a study comparing the effectiveness of system dynamics with traditional, lecture based, methods of learning about wetland ecosystems. The study tests the hypothesis that students utilizing a system dynamics approach learn more and retain more of the material presented to them than with the traditional teacher-based approach. Students from the Las Vegas school district participate in one of two treatments, as the experimental or the control group. Students in the experimental group are presented with a lesson utilizing four system dynamics models about the Wetlands Park Nature Preserve (WPNP) in Las Vegas, Nevada. Students are given a pretest, prior to instruction, and a posttest two weeks after instruction. To assess student learning, understanding, and retention, scores on the pre and posttest are analyzed.

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Dynamics of Innovation Implementation in Social Service Organizations

Successful implementation of innovations is central to social service organizations' effectiveness and improvement of services to clients. Yet administrators face a host of challenges and implementation failures are

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common. This paper discusses the nature of the innovation implementation as inherently dynamic, endogenous to the organization, and constrained by conditions of bounded rationality. Several system dynamics models of innovation implementation are reviewed from manufacturing, health, and human services in terms of their appropriateness and evidence base for social services. Recommendations for practice and a research agenda offered.

Applying A Value-Added Systems Thinking Model to Construct A Professional Development Program on ARTS Education

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Arts education has faced many critical challenges in large part because there has been a severe, chronic shortage of fully certified/qualified arts teachers in Taiwan. The paper provided an overview of the process of designing and developing a web-based professional development program on arts education using a value-added systems thinking model. The authors defined "value-added" as the teacher-centered quality added to the total program by the members of virtual community during the study. The interaction within and among three sub-system thinking models: curriculum and instruction designing, organizational learning, and technology supporting were interrelating as a whole via the web as a tool. A team including 10 music, visual arts, and performance arts expert teachers tried out, evaluated, and revised operational strategies applying systems thinking to meet the National Integrated Arts Curriculum Policy for later use on teacher training. Teachers' satisfaction with the program design and achievement of the program objectives were assessed using the analysis of the data collected from forum, e-mails, questionnaires, and interviews. Implications of the study were discussed.

Teaching Strategic Management with the Industry Evolution Management Flight Simulator

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The traditional way of teaching strategic management at business schools is the case method. While it aims to provide a simulated environment for strategy formation, the case method has several limitations. Many of them can be overcome through the use of Management Flight Simulators (MFS) by combining computer simulation models with conventional case studies. While many existing MFS focus on specific industries, we developed an Industry Evolution Management Flight Simulator that captures the generic industrial structure with endogenous firm entry and exit. For effective teaching purposes, we then introduced staged game design, and tested both the MFS and supporting materials and pedagogy in strategic management classes at the MIT Sloan School of Management. We started with a version for a relatively simple competitive situation, represented by the salt industry, with pricing as the only decision variable. Later in the course we introduce a version for a more complex strategic setting, represented by the video game industry,

where players make multiple decisions and where additional feedbacks are relevant, including network effects, complementary assets, and pricing in both the console and cartridge markets. Preliminary results are discussed.

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Low Income Housing in the Context of Jay Forrester's Urban Dynamics: A Lesson in Framing

This paper is a challenge to Jay Forrester's Urban Dynamics model. The resulting alternative model is compared to Urban Dynamics by running tests of actual U.S. Housing policies.

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What is the Use of Basic Dynamic Tasks?

The various purposes for which a dynamic tasks might be constructed, such as to test for knowledge, teach, or to assist professionals or the lay public in understanding the systems they are dealing with (or part of), are discussed. The idea analysis method is suggested as a means to fit a task to its purpose. Idea analysis entails analysing the task in terms of what basic ideas need to be familiar if one is to be able solve the task. It is just as important to know what knowledge a task does not require as to know what it does require, and if the requirements corresponds to the goal(s) motivating the construction of the task. To provide an example, the Computer Security Incident Response Team (CSIRT) task, a close analogue to the one-stock reindeer management task by Moxnes, is analysed, and several issues of general importance are revealed.

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The Analysis of Newly Gained Feedback Loops after Introducing the Grade-Salary Incitement to HR Management System

In order to find some effective management policy by the feedback loops analysis of a complex system, we transformed the rate variable fundamental in-tree model of SD to a diagonal-0 branch-vector matrix using the method combining graph theory and algebra to work out there are how many newly gained feedback loops in a SD model when a new management activity was introduced into. We created a SD model of a human resource management in an organization, and using this new method, we proved that there were 16 positive and 17 negative newly gained feedback loops by introducing a new HR management of grade-salary incitement on performance level. We proved that the grade-salary-incitement improved the organizational performance, but on the other hand, it restrained the performance of the organization because of the increasing cost. By analyze the growth limited structure model, we find the policy of using the grade-salary-incitement to increase the performance of both the employees and the organization better.

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Using System Dynamics to Extend Real Options Use: Insights from the Oil & Gas Industry

The current work examines the application of system dynamics to real options through work with a major energy firm to apply real options. Five key challenges facing the real options community are presented and potential system dynamics contributions to these challenges are discussed. Two cases from a BP research project illustrate how system dynamics can be used to develop and value real options. The work shows that the use of systems dynamics in real option development and valuation can 1) address key challenges facing the real options community and increase the use of real options in the oil and gas industry 2) allow system dynamicists to offer increased value in developing and valuing flexibility and 3) open system dynamics to new markets of research collaboration and potential clients.

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Project of the Future Vision: Using System Dynamics to Achieve 'Model-in-Loop' Project Planning & Execution

The current work presents and discusses current insights from an ongoing BP Project Dynamics R&D program that supports a 'Project of the Future' vision enabled through the use of formal system dynamics modeling. The BP capital investment environment and the importance of effective capital project planning and execution is discussed. The role of system dynamics in BP's project training approach and early adoption trends favoring conceptual versus formal model tools are reviewed. A formal modeling application conducted in parallel with an actual project assessment that used a traditional approach is detailed and contrasted to provide a direct comparison. In particular, we describe the traditional project assessment approach, how a formal system dynamics model was introduced and used, and how the quantified results influenced both the project and participants. We then identify key learning's and how a 'model-in-loop' concept supports the 'Project of the Future' vision. Finally, we briefly discuss implications for future R&D efforts.

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Risk Adjusted Pricing Strategies for the Corporate Loans Business – Do They Really Create Value?

For a fairly long time, the German corporate loan business has been regarded in publications on the subject as leading to value deterioration. On the basis of the bank lending statistics of the Deutsche Bundesbank,

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our analysis clearly shows a cyclical as well as a structural problem preventing the big four German banks from creating value. In order to analyze possible strategies to solve this issue within a systemic approach, we built a model which included almost 200 variables. Running this model until the year 2010 the outcome is appalling: the break-even return on equity will not be reached. We therefore modelled in a second step the widely discussed strategy of risk adjusted pricing. The outcome raises hope – although this strategy in itself is not sufficient to solve the problem entirely, the return on equity can be increased.

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South Africa's Motor Industry Development Programme: A Case for System Dynamics Approach

South Africa's Motor Industry Development Programme (MIDP) adopted in 1995 was hailed as a successful and innovative industry policy by all stakeholders. Despite attracting significant investment by almost all major global vehicle manufacturers, consensuses is declining that the programme can successfully steer the industry to sustainable future growth. The paper presents findings of an investigation into the declining consensus on the MIDP. A review of the MIDP mental model is done. Industry performance data from 1995 to 2004 is evaluated against programme objectives. Findings show that the declining consensus is due to failure to acknowledge interrelationships among industry variables. The programme success has not been across board and policy makers have paid little attention to synergies between industry sectors. The MIDP presents a classical case of a system dynamics problem that can benefit from system dynamics modeling.

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Research Based on Two Pillars: Combining Qualitative Empirical Social Research and Simulation in Strategic Management

This paper proposes a combined research approach of simulation and modeling and qualitative empirical social research. Modeling and simulating may reveal valuable insight into real world systems consisting of a complex structure. Yet, published data on structures, like learning alliances, are oftentimes limited and stand side-by-side, without interrelation. Qualitative empirical social research might provide model builders with appropriate missing data. Though applying real-world data has long tradition in System Dynamcis, a comprehensive scientific explanation is still omitted. In this paper we view modeling from an outsider perspective, like, i.e., an alliance scholar who needs to be convinced about the benefits of simulation and modeling. Model quality and model acceptance, among other things, depend on realistic model input, including non-rationality or real-world policies. We analyze how qualitative empirical social research may ensure that the model builder works with real-world input that she might use for building the simulation model and for her analysis.

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A Dynamic Simulator for the Management of Disorders of the Body Water Metabolism

In this study, a simulation model is built to study the body water regulation and its disorders by focusing on the fundamental feedback mechanisms in the normal and disease physiology. This model is then extended to include related therapeutic interventions of the most common body fluid/electrolyte disorder, namely water intoxication/ hyponatremia, and a game version is produced to test the possible effects of a given set of treatment options on a simulated patient. The model is shown to adequately reproduce the changes in the body fluid balance not only in a normal person as a result of a given disturbance, but also in a hypothetical hyponatremia patient. The interactive simulation game version of the model proves to be a useful experimental platform to describe changes known to occur after administration of various pharmacological means. The aim of the treatment is to increase the extracellular sodium concentration safely by reducing the body water and replenishing the sodium deficits. Game results demonstrate that hypertonic saline should be given carefully concurrently with drugs that increase urine flow, and antidiuretic hormone-antagonists happened to be superior over diuretics. The model and the game version constitute an experimental laboratory for a closed-loop therapy approach to hyponatremia.

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Comparing Systems Thinking Inventory Task Performance in German Classrooms at High School and University Level

Since the introduction of systems thinking inventory tasks or “Bathtub Dynamics” tasks in 2000, an increasing number of researchers and educators have confronted various student groups and post-graduates with these tests to assess and evaluate their understanding of basic system thinking skills and system concepts. Surprisingly, the results showed a poor performance. This motivated us to subjecting students in Germany to the Bathtub Dynamics tests so as to broaden the international research data and to gain a better understanding of the current level of system thinking skills in selected student groups at our educational institutions. Three different groups, two at university and one at high school level, received the same tasks. The performance results were compared to each other and to other research studies that applied the same tests. The task results were assessed to discover any correlation with the subject’s demographics, such as age, gender, previous degrees or university courses. As was shown with other studies, the overall performance was poor given the participants’ education level. The interesting aspects are the specific differences in performance between and within the individual groups and the relationship to demographic factor such as gender.

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Parallel Dual Problem of Optimization Embedded in Some Model Type System Dynamics

Some kind of dual problem of optimization, on the base of simulation on the model type System Dynamics, is presented. Authors refere to question of, so called, optimization embedded in simulation. Some new results of experiments with the comparison of the solution of the minimization of cost and maximization of profit in the firm are described. The generalization of formulation both problems in matrix form, on the example of described model type System Dynamics is proposed.

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Simulations and Insights From The Enterprise Sales Learning Curve

T.P. Wright (1936) described the learning curve theory, that repetition of the same operation results in less time or effort expended on that operation. While many studies have examined the learning curve under various situations such as manufacturing (e.g., Argote and Epple, 1990) and customer service (Dart, Argote, and Epple, 1995), surprisingly little attention has been given to companies for whom learning is an imperative for immediate survival – those companies with very few accumulated resources and therefore little time to learn before organizational collapse. Leslie and Holloway's (2005) "Enterprise Sales Learning Curve" attends to early-stage companies by addressing factors within the organizational learning system, but with a rather static approach to the inherently dynamic learning phenomenon. This paper animates Leslie and Holloway's framework and addresses the key question: "How do early stage companies allocate their scarce resources to accelerate the progress of their sales learning curve?".

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A System Dynamics Model of an ERP Application Designed to Produce a Transformation of IS Business Processes

(With acknowledgement to the contribution of Simon Taylor) A number of papers have been published describing various System Dynamics [SD] models of the Information Systems Investment Appraisal [ISIA] process from several academic and professional viewpoints. This paper builds on previous papers by the author and others that have produced a taxonomy of SD Models of the ISIA process. This paper adds to the taxonomy by describing a study that produced a simplified System Dynamics Model of an intervention based on an Enterprise Resource Planning [ERP] application and designed to produce a transformation of certain IS business processes in a professional services company. This acts as an exemplar of one of the model types described in the taxonomy – the "Business Value of Process Change" type and compares "before and

after" the intervention models. You are welcome to discuss your ideas and contributions to any aspect of the evolution of SD Models of Information Systems Investment Appraisal at this session!

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Development of a Strategic System Dynamics Model of Dryland Salinity

Dryland salinity is an insidious problem which progressively degrades arable or marginally productive farming land often to the point that such land becomes incapable of sustaining agriculture in the long term. In Australia, this problem has been exacerbated by the removal of millions of trees to make way for cultivation. This paper explains how founding research focusing on identification of reference modes of behaviour for dry land salinity has been used to define the requirements for a system dynamics model designed for strategic analysis and to inform choices for strategic management of dryland salinity in Australia's Murray-Darling basin. The system dynamics model constructed on the basis of the previously identified reference modes is described. Its behaviour is analysed and its veracity as an explanation of the causes of dryland salinity, and possible remediation of this widespread and worsening problem, are critically examined.

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Implication of the Dynamic Decision Making Research on the Monetary Policy Making at the Federal Reserve

The study of Dynamic Decision Making (DDM) has contributed to our understanding of the behavior of decision makers in the dynamic decision making environment. This article attempts to apply the findings of the previous DDM research to the monetary decision making at the Federal Reserve Board. The monetary policy is a typical example of the DDM. By analyzing the Federal Open Market Committee (FOMC) meeting transcripts, the decision making environment and behavior of the FOMC will be identified. The FOMC members face unfavorable decision making environment that corresponds with the DDM findings, but it is also revealed that they were able to develop ways to overcome the difficulties. This article also suggests possibilities of future DDM study and application of DDM prescriptions to the FOMC decision making.

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On Building a Dynamic BSC Model for Strategic Performance Measurement in Public Sector

The issue of performance measurement is getting more critical to the public-sector organizations as well as the private domain as environmental changes become more dynamic and complex. Recognizing the importance of intangible assets, the public organizations have started to introduce Balanced Scorecard as a means of managing and measuring their performance. Unfortunately, however, BSC, a wisdom of the private sector's, is not properly workable unless it is modified by reflecting the unique characteristics of the public

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organization. In addition, the traditional BSC fails to accommodate into its model the dynamic structure within which indicators are interrelated and interacting with time delays. Therefore this paper aims to devise a dynamic-BSC model appropriate for the public organizations by introducing the system dynamics concept with a focus on the effect of casual relations and the interactions among the key indicators and taking into account the impact of delayed feedback caused by new policy and legislative changes.

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Group Learning Supported by Simulation model an Experiment Design

This paper addresses the influence of individual and group information feedback on a decision process supported by the application of system dynamics model. The experiment considered the task of strategy determination with an explicitly defined criteria function under three experimental conditions: a1) individual strategy determination supported by just Causal Loop Diagram (CLD) explanation, a2) determination of strategy with application of the system dynamics (SD) model without group interaction, and a3) determination of strategy with application of the SD model with restricted subject interaction supported by group information feedback. The hypothesis that model application and group feedback information positively influence the convergence of the decision process and contribute to higher criteria function values was confirmed. However, the difference of frequency of simulation runs suggested that group membership might have affected the group work. To eliminate this possibility, we have introduced a pseudo-Solomon experimental design. A model of learning was developed as well.

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Applying Models to Forecast Mobile Service Market Development

Paper presents a system dynamics approach for modeling mobile service competitive market of the region and forecasting market development. The model includes dynamic competition between operators. The pricing policy, service quality, subscriber base, potential subscribers, marketing, etc influence their number of subscribers. The task of defining the market share carrying capacity to forecast the sales process is described. The method for the saturation level identification is considered and the problem of the optimal pricing is formulated. Real data from several regions of Russia are used in this paper.

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Price Trends Dynamic Model of Housing Premises Rent

Housing premises rent has been big socio-economic and political issue in the Czech Republic for a long time. The calculation model of maximum rent for square metre of a housing unit has been changed several times since the year 1994. It has not been assessed stable policy in this branch. As a consequence of this was expensive housing premises rent particularly in Prague. A new law concerning one-sided rent increase should bring a clearer concept. The law was authorized by parliament on 1/3/2006, will come into force by 1/10/2006 and will stand by 31/9/2012. The purpose of the project has been to create a price trends dynamic model of housing premises rent in Czech Republic in this period. All study has been divided into two parts. First one of them includes price trends of rent analysis between the years 1994 and 2005. There are introduced approaches to rent calculations and its values in Prague for various flats categories including rent increases. The second part deals with a price trends dynamic model of housing premises rent according to new law noted in full paper. There is also described the calculation model.

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Representing Logic/Reasoning in System Dynamics Models

This paper intends to fuel a thought about representing and extracting reasoning in System Dynamics (SD) models. A perspective on the flow of information as policies in the system and also flow of information as logical structure or reasoning of the model is discussed. It also discusses how influences in the model are implemented as rate equations and challenges the impossibility in deriving rate equations from the qualitative model. This paper raises concerns that the qualitative SD model normally describes the principle behaviour of the system in dual mode whether a growth or decline and omits the structure of reasoning in the model. Finally this paper argues that the logical structure of policies, if effectively represented at the formulation stage would open a channel for a revived and renewed process of developing SD models.

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Model based development of criteria for the evaluation of rural development initiatives

The proposed poster aims at identifying the economic, social and political conditions un-der which rural regions succeed in overcoming

locational and structural deficits and creat-ing new economic sectors as old ones decline. In addition it aims at developing policies that encourage the transformation process from lagging towards leading regions. For this purpose, a dynamic simulation model is developed. It captures the main feedback processes that run through the relevant theories and it is applied to two case study re-gions, one in Switzerland and one in Norway. Both regions have the potential for trans-formation because of planned infrastructure projects and economic activities. Economic development in the two regions faces questions of resource use, cultural dynamics, and the role of public policy. The application of the model to the two case study regions results in the identification of generic processes behind regional rural development and the requirements for a trans-formation from lagging to leading region. It is also possible to analyze the effectiveness of regional policy measures under a wide range of socioeconomic and political conditions.

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Achieving Balanced Organisational Structure In Professional Services Firms: Some Lessons From a Modelling For Learning Project

Every professional firm must satisfy three goals: client service, professional satisfaction of the people and financial success to reward staff and grow. Therefore, the management of a professional firm requires a delicate balance between the demands of the clients, staff and economic profitability. Using system dynamics methodology, this study analyses the dynamic problems facing professional services firms and how can be achieved a balanced organisational structure. The study is based on a modelling project aimed to help the process of staff budgeting of a professional services firm in the financial industry.

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Decision Patterns and Information Availability in the Beer Distribution Game

In this article we present results of different experiments with the Beer Distribution Game focusing on decision patterns and the effect of varying information on the decision quality. Besides the known decision patterns such as the ordering heuristic presented by Sterman (1989) and the well investigated bullwhip effect in the Beer Distribution Game, we make two other observations. First, as an extension to available studies, we suggest that decision behavior could be explained by policies that change over time. Second, a non linear relationship between the anchor and the decision is presented and contrasted to the linear heuristic. Information seems to play an important role in the decision making process, but the effect is not necessarily positive. This could be explained by coordination problems. Overall, the complexity of the Beer Distribution Game raises various questions about the experimental design.

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Dynamic Analysis of the Long-Distance Telecom Bubble

It is well known that the long distance telecom service providers suffered heavy damage in the aftermath of the telecom bubble. What is it about the telecom industry that drove participants to fall victim of the bubble dynamics despite historical understanding of the destructive consequences of past bubbles? Was the bubble simply the result of a "perfect storm", or was it an inevitable reflection of industry dynamics? To what degree did the bubble arise from irrational exuberance and misperception of demand growth, and to what degree did it simply reflect pathological emergent behavior arising from individually rational actors? The answer to such questions are interesting historically, but may also help provide insights for regulators and enterprises. The objective of the analysis described in this paper is firstly to use system dynamics to characterize the telecom bubble phenomena, secondly to analyze and understand the mechanism of the telecom bubble, and thirdly to utilize the model to make preliminary recommendations that may help to lower the risk of similar phenomena in the future. The model provided insight into the impact of factors such as technological advancement, misinformation concerning demand growth, competition among network service providers, and the impact of demand forecasting techniques.

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Modeling the Productivity Crisis in Pharmaceutical Research using System Dynamics

This paper presents a model that characterizes the main feedback loops at the core of the so called productivity "crisis" in pharmaceutical research. For a number of years, the pharmaceutical industry has witnessed a sharp increase in R&D investment, while the number of drugs released on the market have significantly declined. Many studies have looked at the issue, but none has proposed a synthesis of these factors in a single unified systemic model. Based on a detailed and careful examination of the data for the past 15 years, and secondary studies, this paper expounds on the business behavior observed in the industry in connection to the dynamics of the drug development process. The conclusions from the results generated by this model suggest an explantory hypothesis that the productivity dynamics observed in the industy, might be due to the endogenous behavior of the firms in the sector with an overemphasis on perceived short-term gains from M&As, at the expanse of investment in R&D. The paper shows the main feedback loops of the model and illustrative results are presented.

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Systems Thinking on the Dynamics of Knowledge Growth - A Proposal of Dynamic SECI Model

This paper investigates a dynamic mechanism underlying the process of knowledge creation and evolution with a focus on the SECI model(standing for Socialization, Externalization, Combination, Internalization) as proposed by Nonaka and Takeuchi(1991) and broadly accepted especially among the practitioners in knowledge management field. The SECI model provides with intuitive logic and clear delineation of knowledge types between the tacit and the explicit, and embodies an interaction dynamic. However explanations of the propelling forces for the knowledge transfer over the four quadrants of the model is yet to be made. And the transmission mechanisms are not prescribed though the model mentions knowledge is created and evolved in a spiral process. This paper, therefore attempts first to extend and elaborate it into a dynamic SECI model by identifying those propelling factors and their relationships (linkages) based on the systems thinking.

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Exploring Contractor's Opportunistic Bidding Behavior and its Impacts on Construction Market

Competitive bidding system, bearing the advantages of simplicity and fairness, is expected to encourage economic benefits through the free market competition mechanism. However, as the characteristics of construction industry are different from those of other industries, many issues such as abnormal low-bids and poor project quality have been derived from the competitive bidding system, and hinder the development of the construction market. By using System Dynamics this research developed a contractor's pricing model consisting of two intended economic feedback structures with competitive bidding philosophy and an unexpected adverse one, namely Opportunistic Bidding feedback structure. The results suggest that the ideal competitive bidding system is only effective when contractor's opportunistic bidding behaviors are restrained. The emphasis of government's policies should be placed on inhibiting the Opportunistic Bidding, as it is the leverage point to improve the efficiency of public construction market.

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Overlapping in Distributed Product Development

Market and technology changes have brought about new characteristics of product development. One of the most significant changes from the traditional to the new paradigm is the change from sequential and

collocated product development process to overlapped and distributed process. This paper explores the appropriate overlapping policy in distributed product development based on a system dynamics model. The major contribution of this study is to suggest that it is very dangerous for a company to develop innovative products with distributed teams. Not only coordination time but also wrong overlapping policy makes delay unavoidable for the distributed and innovative projects. The simulation results are empirically proven by our experience in the consumer electronics companies and previous literature.

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Towards an orientation framework in multi-modeling paradigms

Methodologies are built upon fundamental assumptions (called paradigms) which are rarely questioned within a respective community. When applying a methodology without being aware of these assumptions we risk accepting wrong conclusions (abduction risk). Therefore this paper proposes that the development of valuable simulation models strongly depends on the sound alignment of purpose, object and methodology. In order to align these dimensions and in the light of upcoming tools capable of multi-paradigm-modeling a clear conception of the available methodologies, their differences and suitability becomes a necessity. In the context of modeling and simulating of socio-technical systems three methodologies seem reasonable. Next to System Dynamics (SD) these are Agent-based (AB) and Discrete-Event (DE) modeling and simulations approaches. The following paper analyzes and compares all three approaches in order develop an initial concept idea for an orientation framework which aligns purpose, object characteristics and methodology for choosing and/or combining suitable modeling approaches.

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Trust and Collaboration in Interagency Information Technology Projects

This paper presents a model providing a feedback structure that clarifies the nature of the reinforcing processes involved in the development of trust through collaborating in a project. The feedback structure is grounded in data from a project where a prototype system was built, and it is consistent with the literature on trust, collaboration and diffusion of innovation. Four feedback processes are identified at the core of the development of trust and collaboration, two of them reinforcing in nature, and two of them counterbalancing in nature. Experiments with the model suggest that the initiation of a collaborative project with a new partner has the potential to have a slow start because of the lack of knowledge about the other parties. The initiation of the collaboration could be accelerated by shaping expectations of benefits of the project or by reducing the perception of risk associated with the project.

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Borders as Membranes: Metaphors and Models for Improved Policy in Border Regions

Political borders are controversial and contested spaces. In an attempt to better understand movement along and through political borders, we applied the metaphor of a membrane to look at how people, ideas, and things "move" through a border. More specifically, we employed this metaphor in a system dynamics framework to construct a computer model to assess legal and illegal migration on the US-Mexico border. Results from both quantitative and qualitative data searches were used to modify a 1977 border model to demonstrate the dynamic nature of illegal migration. Model runs reveal that current US-policies based on neo-classic economic theory have proven ineffective in curbing illegal migration, and that proposed enforcement policies are also likely to be ineffective. The modeling supports views expressed in the current literature suggesting that demographic and economic changes within Mexico are likely to slow illegal migration by 2060 with no special interventions made by either government.

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We'd rather not XMILE: model interchange standards and software competition

There have been a number of articles describing the desire, by the system dynamics computer modeling community, to establish a common model exchange language (XL) for system dynamics models. Contrary to the seeming increase in the common good resulting from such an exchange language, as of today, none of the major vendors has stepped forward to implement this exchange language. We propose to demonstrate, within a strategy framework, the consequences of implementing the XL and the reasons why the apparent disinterest shown by the software community in the XL is intrinsic to markets of this type.

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Resource Allocation in Acquisitions: Tradeoffs Between Integration and Operations

In mergers and acquisitions, a tension arises between devoting resources to activities relating to the integration of the merging firms at the expense of assigning them to ongoing business operations of the target and acquirer. Although numerous scholars have identified this resource tradeoff as being critical, the dynamics and implications thereof remain unexplored. In this paper, we examine such resource allocation decisions, by investigating the impact of integration and operational resource allocation decisions on the post-acquisition product development process in innovation-targeted acquisitions. These aspects are explored through an empirical investigation and a simulation analysis drawing on the acquisitions conducted by leading firms in the telecom networking and

software industries. The findings contribute to our understanding of resource allocation processes, acquisition implementation, and innovation management.

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Methodology for a Graduate course to change paradigms, from the analytical approach to the systems dynamics thinking

This paper describes the methodology developed to cover the multiple challenges to pack in a three-month period three basic issues: changing the analytical paradigm to the systems thinking; introduce the tools of systems dynamics for modeling complex phenomena and apply on a real problem the simulation of the modeling. We describe how we do this, the barriers founded and some results and findings obtained from more than 15 years of experience with this methodology. The most important outcomes are: the type of projects that the students have developed (all of them are real situations that involve social case) and the development of student's capability of systems thinking: from an analytical reductionism to a systemic expansionistic thinking. In conclusion, this approach change successfully the students´ way of thinking and acquire skills for modeling and simulate complex situations. Key words: System thinking, system dynamics, simulation, skills development, changing paradigm, methodology, face-to-face, e-learning.

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Potential niche development in the Autoparts Industry in Mexico base on electronic components

The industry of autoparts presents problems as lack of reinvestment from companies in this economic area, the dependence of foreign investment and the lack of specialization in the autoparts of greater value as the electric and motor parts. The specialization in electric autoparts would permit to increase the position in the market, increasing the percentage in the market share and high utilities recovery for the industry reflected through a percentage of return of the greater investment. These advantages that would be obtained from a reinvestment distributed in the industry will permit to Mexico to be in the vanguard in electric autoparts with the possibility to compete with world leaders and entering to new markets as Europe and Asia. In this paper a model is proposed to evaluate the viability to develop the specialization in electric autoparts inside a cluster in Mexico.

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e-learning approach for systems dynamics successfully knowledge transfer and skills development

This paper presents an holistic view of the challenges faced and the success of knowledge transfer and skills development, when teaching the

changing paradigm of systems thinking, systems dynamics and simulation, through e-learning and the potential of developing a ST&SD virtual community. A case of study describes the essence of the methodological framework proved and designed under the "thought on-line" approach. Action research method was used to observe the evolution and to evaluate: new knowledge, skills developed by pupils and their improvement on the changing paradigm. This is part of an on-going research; we present the insights gained from preliminary results about the achievements up-to-date. Followed by some general considerations when offering this kind of topics on a distance learning environment and what to do to obtain a successfully experience for newcomers. At the end, we present the future vision of a growing ST&SD virtual community, its potential and some of its goals.

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Integrating Judgment and Outcome Decomposition: Exploring Outcome-based Learning Dynamics

This paper presents a preliminary exploration of the integration of social judgment theory and signal detection theory using system dynamics modeling as a means to increase understanding of the prototypical judgment-decision-action problem present in many systems and circumstances. This integration, by allowing the decomposition of both the judgment process and resulting outcomes, offers a unique framework to explore the fundamental mechanisms associated with learning dynamics using outcome feedback. The dynamic framework built incorporates judgment, decision making, and outcome-based feedback in an integrated model.

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Stock Market Fluctuations and the Impact of Socio-Economic Uncertainty on It

Developing strategic policies which could protect the stock market from wild fluctuations and bubbles is a challenging area in financial management. When the price index rises fast, the chances of its collapsing increase. The collapsing of bubbles leads to large negative returns. Researchers have argued the stock price behavior does not always follow the economics fundamentals. There are nonlinear and complex factors affecting changes in the stock prices. System dynamics as a way of analyzing complexity and nonlinearity could give us a new perspective to analyze the dynamic behavior of stock price index. This paper develops a SD model based on two significant and fundamental theories in finance, Behavioral and Classical theories, to examine main causes of growth and collapse of stock market index. The impact of macro socio-economical environment on stock market fluctuations is also

discussed. The predictions of the model are validated based on cross-sectional data from different countries. Keywords: System Dynamics, Stock Exchange, Speculative Bubble, Financial Management, Behavioral Finance.

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Supply Demand World (SDW): An Interactive Learning Environment for Teaching Microeconomics

Economy is dynamic and changing. One of the biggest problems with the introductory economics courses is that they are too static. System Dynamics can help us in teaching dynamic aspects of economy. "Supply Demand World" (SDW) is an Interactive Learning Environment (ILE) to teach introductory microeconomics based on the system thinking and system dynamics concepts. The paper presents the underlying system dynamics models used in the software as the base of the games and other teaching materials. It also introduces the teaching structure used in the software based on the learning theories discussed in the paper. Furthermore, the paper presents many unique features of the software and discusses how these features supports learners in developing a better understanding of the subject. An experiment conducted in a high school, to measure the teaching effectiveness of the software, shows that students worked with the software achieved much better results compared to the students did not work with the software in a similar test. The test was designed to measure students' understanding of the basic system thinking, system dynamics and economics concepts.

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Extended Sensitivity Analysis of Parameters and Structure in System Dynamics Models - Some Case Study

The problem of sensitivity analysis of parameters and structures in System Dynamics models is rather new for field modelers. The possibilities of packet COSMIC and COSMOS allows to apply extended sensitivity analysis not only of parameters of the simulation models but structures of these models too.

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Supporting the Decision Making Process of a Brazilian Apple Producer – A Challenge for the Owner

Our purpose with this work is to present and discuss an application of the System Dynamics method in a Brazilian agricultural company, discussing the challenges, benefits, problems and results of a consultancy project aimed to support the company's strategic and operational

decisions. Using Group Model Building methodology and the software iThink two models were built, and an important change in the planning process was implemented. The first model, representing the production and debt structure of the Company was created to support long term investment decisions. The second model showing the Company's financial structure in detail was created to support the annual planning, budgeting activities and to test commercial decisions. The results achieved show how System Dynamics can be used to improve the decision making process and to support the management and the owner learning process.

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Restoring the Balance: The Dynamics of Decline of China's Health System with Economic Market Reforms

China's economic transition from a planned soviet economy to a socialist market economy has resulted in substantial changes to its health system, with a significant impact on health outcomes and equity of access. This paper extends recent US health reform system dynamics work to synthesise the China health reform story in causal loop diagrams and illustrate it with available trend data. The analysis is based on translated papers from a high level Chinese Government think tank to plan health system changes for the next Five Year Period (the Flourishing Society). Its main recoommendations include extending financial coverage, focus on upstream interventions (public health, prevention and common disease interventions), and strengthening government responsibility) This natural experiment can provide insights into the problems associated with transition from hierarchical to market control mechanisms and the linkage between the overall socio-economic context and health care. KEYWORDS: Health Policy Dynamics, China Health Reform, Socio-Economic Context.

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Exploring the Political and Economic Dimensions of Health Policy

This paper extends recent systems approaches to US health reform to the international sphere and explicitly represents the political and economic dimensions of health policy. The worldviews of health care as an industry with user as consumer, a profession with user as patient, and a societal right with user as citizen. Historical institutionalism and agency theory in health policy are represented and integrated, with focus on the extent and interaction of hierarchical, market and network control mechanisms on key system performance goals. This work can inform simulating international comparisons of health systems evolution and explicitly representing their 'strife' of less tangible political and vested interests, in order tounderstand, plan and test the acceptability of proposed health reforms in various countries and regions KEYWORDS: Health Policy, Health System Dynamics, Health Politics, Health Economics.

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Defence Capability Management: Introduction Into Service of Multi-Role Helicopters

Upgrading Defence capability involves much more than acquiring new hardware such as weapons or aircraft. This paper demonstrates how system dynamics modelling was used to assist in planning and management of the introduction into service of a new generation multi-role helicopter type. It describes the challenges of managing resources; and the complex interrelationships between tasks such as the training of pilots and aircrew, conducting maintenance on the aircraft and the achievement of defined levels of capability to conduct military operations. Whilst the modelling task focused initially on the management of human resources, it soon became obvious that complex dynamic problems are best addressed using a top-down approach, to achieve optimisation at the system level rather than attempting to optimise sub-systems. The modelling approach exploited trusted, functional modules of system dynamics structure rather than ab initio model construction. How this aided model construction and verification is described.

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A strategic model for evaluating investment strategies to establish operational & financial sustainability of Pakistan Railways

This paper formulates and analyzes a strategic model for Pakistan Railways. The objective of the model is to understand the potential consequences of investment strategies aimed at establishing operational and financial sustainability of the Pakistan Railways. The model replicates a wide range of inter-connected causal relationships between different factors to reflect the decision making process in the sectors including Rolling stock (passenger coaches and locomotives), Maintenance of Rolling stock, Tracks, Maintenance of Tracks, and Finance. The model incorporates how these sectors interact to each other over time. The model can be used for evaluating potential outcomes of individual and combinations of individual investment strategies implemented at different times. The conclusion derived from the model experimentations indicates that a better operational policy for the Pakistan Railways to improve its operational performance and financial sustainability would constitute expanding the track capacity with increased provision for maintenance capacity.

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The Financial Accounting Model from a System Dynamics' Perspective

This paper explores the foundation of the financial accounting model. We examine the properties of the accounting equation as the principal algorithm for the design and the development of a System Dynamics model. Key to the perspective is the foundational requirement that resolves the temporal conflict that resides in a stock and flow model.

Through formal analysis the accounting equation is redefined as a cybernetic model by expressing the temporal and dynamic properties of its terms. Articulated in that form the accounting equation is enabled to be defined as a dynamic stock and flow model expressing the two dimensions of the double-entry accounting system. With that formal foundation it is argued that the accounting model is capable to simulate financial dynamics as well as be integrated with models that express operational and world dynamics. Thus we prove that it is possible to design and build a dynamic business model that can meet requirements of management accounting (ex ante, before the fact) as well as financial accounting (ex post, after the fact). We conclude that the dynamic accounting model can be made relevant for strategic planning and control purposes and be integrated within a System Dynamics model designed for such purposes.

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World - Grid Type, Continuously Under-development - System Dynamics

World - Grid Type, Continuously Under-development - System Dynamics The main goal of United Nation is realization of sustainable development world society vision. Such society need to integrate social development with economic development and environmental protection. For this end it is necessary to enable sustained economic growth, internalizing externalities and decoupling the range of economic growth from the range of deficit natural resources depletion growth and degradation of environment. In order to achieve above UN Goal we have to build WORLDWIDE, COMMONLY ACCESSIBLE, SUSTAINABLE DEVELOPMENT-INFORMATION SYSTEM for: - comprehensive monitoring, - far-sighted forecasting, and - measurable evaluation, of policy, economy, work, and other changes effects in life-conditions of human-beings and nature in general. This system ought to be built on the base of System Dynamics. We propose research program, which allows to describe conditions of creation such big, grid type, multi stage built, information system.

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To TREND or not to: Comments on the representation of expectation formation processes in system dynamics

The paper discusses the representation of expectation formation processes in system dynamics. After a brief overview of current behavioural research on expectation formation, it analyses the implicit assumptions that arise from a representation with exponential smoothing and the TREND function. It addresses the limitations of univariate autoregressive algorithms and illustrates their difficulties in representing the causal reasoning processes that may underlie expectation formation. It is argued that exponential smoothing and TREND actually neglect the importance of causal and systemic reasoning and thus are not in line with the paradigm of systems thinking. Finally, three alternative approaches to modelling expectation formation are outlined.

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Supply Chain Responsiveness and Efficiency – Complementing or Contradicting Each Other?

Balancing responsiveness to market requirements with overall efficiency is an important issue in supply chain design and management. The objective of the system dynamics model introduced in this paper is to capture generic structures and the intrinsic dynamic behaviour modes of supply chains considering aspects of responsiveness and efficiency. The research strives for a better understanding of these aspects: what are the structural consequences of implementing strategies striving for efficiency or responsiveness in the real world, and how can they be represented in a System Dynamics model? Furthermore, simulations will be used to assess the dynamic consequences of these different strategic alternatives. Future research will then focus on identifying policies to balance responsiveness and efficiency in a specific industry and by that resolve the trade-off between the two.

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A population ecology approach to capture dynamics of cluster evolution: Using computer simulation to guide empirical research

In this paper, we use the social capital theory to extend the topic about the evolution of industrial districts, aiming to verify whether or not social capital may be considered as a critical source in explaining the dynamics of population of co-localised organisations towards the phenomenon of passive internationalisation. The study explores these issues by analysing the pattern of fragmentation of production and the change of internal rules of actors inside a textile industrial district localised in the Center of Italy – Val Vibrata – after the "internal invasion" of foreign business players in different stages of chain value. We use these empirical data to calibrate a computer simulation model so to generate a number of near-histories that capture possible unfolding cluster dynamics.

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Sustainable Land Use within a Limit of Environmental Carrying Capacity in Metropolitan Area, Korea

The purpose of this paper is exploring changes in land use pattern when considering environmental carrying capacity. Environmental carrying capacity can be defined as a level of human activity a region can sustain at an desired level of quality of environment. This concept of environmental carrying capacity can be applied to explore sustainable land use pattern. Since land use pattern can affect environment in important ways, exploring sustainable land use pattern within the limit of environmental carrying capacity can suggest useful implications for a sustainable regional management and planning. For this purpose, this paper built environmental carrying capacity land use model and applied it to the Metropolitan Area, Korea. The model limits its main focus on the

NO2 level as an indicator of quality of environment in Metropolitan Area. Metropolitan area was divided into 16 areas and the model was applied to each area. Since NO2 is flowing in and out from each area, model was built to allow this transboundering nature of air pollutants. Based on the model estimation, several policy implications for a sustainable land use pattern was discussed.

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Improving Management of Information Technology: System Dynamics Analysis of IT Controls in Context

Ongoing field work centered at the Information Technology Process Institute (ITPI) is finding that change and access controls simultaneously reduce security risk and increase the efficiency and effectiveness of information technology (IT) management and operations. The CERT® Coordination Center is building on this work. This paper describes a system dynamics model that embodies our current hypothesis of why and how these controls reduce the problematic behavior of the low-performing IT operation. We have also started to extend the model in ways that reflect the improved performance seen by high performers. In the longer term, we hope this model will help to understand, specify, and justify a prescriptive process for integrating change and access controls into their business processes in a way that most effectively reduces security risk and increases IT operational effectiveness and efficiency.

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Mining for Insights: Simulating the Dynamics of Process Improvement

The paper develops insights into how the feedback structure of process improvement presents challenges to people in a system facing the dual pressure to produce output and to build capability. To explore this phenomenon, the paper constructs a dynamic mathematical model building on the feedback structure presented in Repenning and Sterman's (2002) study of two business process improvement initiatives. The model formalizes the critical interaction between first- and second-order improvements as options for governing production. Analytical results characterize the optimal tradeoff between working harder and working smarter. However, practitioners generally make choices lacking adequate knowledge of the parameter space to find the optimum. Results demonstrate tipping points in the dynamics of process improvement and identify perverse behaviors that are likely to thwart the good intentions of practitioners. By moving from causal loops to a simulating model, the paper also provides an example of how formal modeling yields more nuanced understanding.

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Individual transferable quotas versus auctioned seasonal quotas, an experimental investigation

Fishery policies have largely developed in response to current problems. One of the last policies to be implemented is individual transferable

quotas, ITQs. This seems to be a promising policy instrument compared to those which have shown weaknesses. Extrapolating from previous experiences, however, a further investigation of the ITQ system may reveal weakness of this instrument as well, and may help improve the policy or stimulate the development of alternative policies. One such alternative may be auctioned seasonal quotas, ASQs. A laboratory experiment of a market with seven fishing firms is used to compare the two policies. Compared to traditional laboratory experiments, this experiment allows for dynamic adjustments of fishing capacities as well as quotas. Weaknesses and strengths are revealed, some of them surprising. For instance, having to pay variable prices ASQs may lead to less variation in equity than owning ITQs.

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System Dynamics Approach to Envisage the Dynamics of KM & HRM in the IT Sector

This paper focuses on the application of System Dynamics (SD) in the integration of Knowledge Management (KM) and Human Resource Management (HRM) with specific reference to IT sector. The research methodology involves the development of causal loop diagram of engineering competence pool model (ECOPM), based on which, the flow diagram is developed. Further, the control loop is set up to represent the ECOPM and simulation is performed for the dynamics of HRM and KM in terms of recruitment rate and competence/skill pool development. The simulation results envisage the effect of the policy parameters through which implications are drawn to better the policy analysis and implementation. In this era of knowledge driven economy, building core competencies is inevitable, particularly in a creative field such as engineering, and hence, the results of this study would enhance the efficacy of the managers responsible for policy making in manpower planning.

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Reducing the processing time in a civil case; a project conducted for the Dutch judiciary

In the Netherlands it can take more then a year to get a verdict in a civil case. This is not desirable from a social and economic point of view. The judiciary has made it one of its top priorities to reduce the processing time in the next couple of years. In order to gain more insight we were asked to use system dynamics to tackle this problem. The only road to success was to make sure that all stakeholders fully supported the model, its outcomes and the drawn conclusions. This paper describes how the civil process at a district court is captured in a model. It shows how we discovered the dynamics of the civil process that were unknown until now. This new insight has lead to a change of the perspective of the decision makers in what are good policies to reduce the processing time. The paper also reveals how a new stakeholder was discovered through the use of system dynamics.

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Wanted: Easy Riders. The Aging of the German Motorcycle Rider Population and its Implications on the Motorcycle Market

The aim of this paper is to build a framework of the motorcycle business in Germany, which can be used to construct a quantitative System Dynamics (SD) simulation model thereof. The problem to be examined is the superannuation and further aging of the motorcycle rider population in Germany and its influence on the whole market. We have chosen to concentrate on Germany – the second largest European motorcycle market – as it is representative of most other developed motorcycle markets. A Causal Loop Diagram of the problem is developed in a step by step, walkthrough fashion. A discussion of the cohort effect with propose possible levers for change are also introduced.

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Applying Modelling Paradigms to analyse Organisational problems

Managing a company requires different tools and methodologies in order to successfully deal with its intangible resources and maintain a competitive advantage. Econometrics, Agent-Based Modelling (ABM) and System Dynamics (SD) are modelling paradigms which allow building dynamic models which is a characteristic of this organisational context. These three paradigms present important differences that could determine their suitability to analyse organisational problems. This paper describes the Econometrics, System Dynamics (SD), Agent-Based Modelling (ABM) modelling paradigms. Next, the paper study how these three paradigms analyse organisational problems by means of a model developed in the three paradigms. Finally, the paper provides a method to validate the assumptions about how the paradigms fit with the requirements to study an organisational problem.

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Low-Dimensional Dynamics in Agent-Based Models

Within recent years, agent-based models have achieved growing prominence in several fields of study. Although powerful and expressive for characterizing the evolution of large populations exhibiting persistent interactions between individuals and high heterogeneity, agent-based methods do not come without tradeoffs. Such methods are burdened by relatively high runtime, lack a formal canonical, declarative, and transparent mathematical semantics, and are often challenging to program, understand, calibrate, generalize and validate. It is therefore important to help modelers recognize modeling contexts requiring the full generality of such models. This paper takes a preliminary step in that direction. Specifically, we built and apply a framework that applies the theory of delay embedding and generic algorithms for intrinsic dimensionality assessment in order to estimate the intrinsic

dimensionality of the trajectory of agent-based models. This dimensionality provides a lower bound on the number of state variables required in any model that seeks to reproduce the behavior of these agent based models. Surprisingly, we have found very low dimensional global behavior associated with highly descriptively complex agent-based models. While many caveats apply, we suggest that there may be opportunities for expressing the behavior of many complex agent-based models using system dynamics models of modest size.

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System Dynamics Model of a New Prenatal Screening Technology

The evaluated ELI-P Complex test is a biochemical system for pre-pregnancy/pre-natal screening used to determine the probability of pathology in pregnancy through the evaluation of the immunoregulatory state of fertile females. This work uses system dynamics (SD) as an assessment tool for the given technology and policy analysis. Simulation is designed to run at a relatively high level of aggregation for the time period between 2010 and 2035. It allows the dynamics of the model to be traced at the population (US) level of technology application in order to conduct an integrated policy analysis for prenatal care under various implementation scenarios of the ELI-P Complex. Simulation results clearly point to the benefits of the ELI-P Complex screening which helps to monitor female reproductive health and to achieve noticeable improvements in the overall health status of new generations. This work is the result of collaboration with a well-integrated network of clinicians, microbiologists and system modelers.

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Systems Thinking for Research and Development Policy Impact Assessment in Latvia

Following EU's Lisbon strategy development of knowledge-based economy has become one of the headline objectives for the government of Latvia. In this paper we conceptualize driving forces and responses of government's commitment towards this objective. We investigate feedback loops that underlie dynamics of knowledge industry development. Increase in domestic Research and Development (R&D) activities is considered as a prerequisite for sustainable growth of knowledge economy. Dynamics of R&D supply and demand is further analysed and leverage points for different policy measures is identified. Scarce human resources is considered as the main impediment for building domestic R&D capability and impact from mix of policy options is assessed.

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Combining Relativism with Logic and Empirical Knowledge: Integration of PIMS with System Dynamics

This paper presents an attempt to integrate the two major opposing streams of philosophy of science, that is, the traditional

reductionist/logical empiricist approach with the more modern relativistic/holistic approach. Even though the two approaches represent opposite views in the philosophy knowledge creation, the combination of the two is possible as they also share common characteristics. As a result the synergetic effects of the combination draw new directions for research methods and model development. The aim of this paper is to combine the explicit knowledge on strategic management stored on the Product Impact of Marketing Strategy (PIMS) database, with the conceptual framework of Systems Thinking, and the simulation capabilities of System Dynamics. The combination is implemented in the form of an integrated generic System Dynamics model, that includes market related factors, quality related factors and system structural factors that influence the success of any management strategy. The integrated generic system dynamics model can serve as a strategic management centre that can be utilized by a Strategic Business Unit in deciding how to compete in an uncertain and rapidly changing environment. Various business scenarios can be tested by simulating organizational operations and environmental processes, whereby effective strategy formulation can be carried out.

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Building a Dynamic Manpower Planning Model: Focused on the Information Security Manpower Policy in Korea

The ability to forecast manpower requirements is crucial for an industry. On the demand side, companies rely on these forecasts to formulate their manpower planning strategies, while, on the supply side, they provide job seekers with a basis to assess the attractiveness of a given sector. Forecasts of supply and demand for manpower also make an important contribution to the governmental policy-making process by serving as pointers, to avoid redundant investments and achieve efficient and balanced growth for an industry. Meanwhile, forecasts based on an inaccurate market analysis can be a cause for imbalances such as undersupply or oversupply of labor. Static and unilateral analyses are the most common culprits for erroneous predictions of supply and demand for manpower. In this paper, we elaborate a model of manpower supply and demand for the information security industry, one of today's fastest-growing sectors, using the system dynamics method. Using this model, we will predict how the labor supply in Korea's information security industry will evolve in the coming years, determine causes for any demand/supply imbalances and propose solutions to resolve these imbalances from a dynamic perspective.

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A Model for a Water Potable Distribution System and its Impacts resulting from a Water Contamination Scenario

Contamination of a public water supply distribution system would have far-raging public health and economic effects. Emergency response

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decision-makers need a tool for quickly calculating resources requirement in the aftermath of a contamination incident. A model is needed to describe the potable water distribution system itself and the cascading effects of a disruption of that distribution system on other public institutions such as hospitals, transportation networks, etc. In this paper we present a system dynamics model describing a potable water distribution system that serves an urban area. This model is a component of the Critical Infrastructure Protection Decision Support System (CIP-DSS) project, which models the dynamics of a set of coupled individual infrastructures. We investigate the interdependencies of potable water distribution systems on other critical infrastructures merging our model with other infrastructure models developed under the CIP-DSS project. The main focus of this work is to study the consequences of a disruption on a potable water distribution system. For this purpose we analyze the effects on public health and the economic consequences resulting from contamination of a public water supply.

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What's behind the blue arrow, the notion of causality in System Dynamics

System Dynamics (SD) is considered a causal modeling approach. Causality is a key and peculiar characteristic of SD: SD models are supposed to contain and represent only causal relationships. However, SD researchers are often not explicit about the notion of causality employed in their work, and there not seem to be a commonly adopted and clear definition of causality in the field. This paper investigates and compares the notions of causality emerging from the work of three major SD authors. The objective is to assess the extent to which a convergence towards a common definition of causality in the field exists, and whether the notion of causality used by the various authors is influenced by the particular field of application. The analysis conduced indicates that the notions of causalities used are similar, and that existing differences could be explained by different fields of application and different backgrounds of the authors.

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Auto parts industry in Mexico: future perspectives

The automobile industry is one of the most important in Mexico. Nowadays, in terms of its relevance in the manufacturing industry, auto parts constitute the second major exported product of the sector, only after vehicles. During the 90's the participation in GDP and the sales volume in the auto parts sector has demonstrated a tendency of growth peaking in the year 2000. Since 2001 up until now a slow decrement has

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presented in the indicators. The auto part industry must convert into a major aggregate value platform, which integrates technology and a major value to the original equipment components and replacement parts. A technology that can be used to constitute this platform is the micro-electromagnetic system technology (MEMS). The document shows diverse developed panoramas under the area of study of System Dynamics, which demonstrate what could happen in this industry in the next 10 years supported by MEMS.

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System Dynamics of the "Safety Net" and U.S. Health Care Reform: The View from an Urban Public Hospital

As U.S.health care costs have gone up, the number of uninsured has increased, at the same time that Medicaid reimbursements and subsidies cover a decreasing share of costs for "safety-net" providers – health care providers servicing Medicaid and uninsured patients. Concurrently, efforts at comprehensive reform of the US health care system have failed. A systems dynamics analysis of the mutual influence of the factors underlying the relationship of the safety net to systemic health care reform, starting with the factors influencing an urban public hospital, shows that any adequate predictions on the viability of health reforms in the US must consider political feasibility, including longstanding principles of American political culture. In the shorter term shoring up the safety net may well forestall efforts at more systemic reform. In the longer term, however, incentives for more cooperation among providers, more reliable sources of reimbursement for preventive services, and increased political support for more universal coverage as more working people become uninsured, could provide leverage that would reverse the cycle of increasing burden on the "safety net.".

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Do we ever halt when solving complex problems?

Why is it that some problem solving tasks in organisations – though well posed in principle – turn out to be incredibly difficult or impossible to solve when taken on in practice? Why is it that after having followed an otherwise ordered and predictable path we often find ourselves suddenly on an increasingly turbulent stretch of road where we realise – to our horror – that our ability to intervene in the unfolding chaos is rather limited? Yes, complexity theory provides many important insights into the dynamics of complex organisational systems and – over the years – we have become familiar with terms like bifurcation points, strange attractors and phase transitions. However, given a concrete organisational or engineering problem, their use remains largely metaphorical. In fact, the complex dynamics is assumed to be given and no account is offered about its actual emergence. This paper, therefore, aims to serve as a kind of magnifying glass that helps us to study the emergence of complex behaviour in organisations. Also, it gives an account why complexity often out-steps us in many problem solving tasks.

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Tourism and Equilibrium Quantities: A dynamic perspective

The systemic approach in studying tourism is firmly accepted in literature because of the complexity of the topic both from the supply side (the heterogeneity of goods and services making the tourist product) and the demand side (not every operator in the tourism network chain has a direct contact with tourists). To face this complexity the Input-Output analysis, theorized by Wassily Leontief, is widely used in the empirical studies regarding tourism. This methodology, however, gives just a snapshot, even very detailed in some cases, of the economic structure under study but gives very few insights from a dynamic point of view. To overcome this limitation the Dynamic Input-Output Model (DI-O model), implemented with system dynamics methodology, is introduced in this paper. Moreover some considerations about the technical sustainability of the production process are made possible by the proposed model.

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System Dynamics and Decision-Making in the Context of Dynamically Complex Multi-Dimensional (Societal) Issues

Dynamically complex multi-dimensional societal issues are societal issues characterised by complex time evolutionary behaviour on multiple dimensions, and very often also by many uncertainties, different ethical aspects, multiple views and multiple parties concerned. In this paper, the use of system dynamics (and multi-criteria decision analysis) for decision-making in case of such dynamically complex multi-dimensional societal issues will be looked at. More specifically will we look at the resulting (potential) capacity to support decision-making in case of multiple dimensions, multiple time scales, uncertainty, multiple decision-makers and third parties, and ethical and sustainable aspects, power, coercion, and uneven distribution. Related to these aspects are robustness, resilience, flexibility and responsibility which will be discussed too.

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What is System Dynamics? A Paradigmatic Inquiry

There is not one single system dynamics approach. Apart from 'mainstream' system dynamics, there are several distinctive practices in use. An attempt is made here to reveal basic assumptions of different practices and to classify them in a paradigmatic classification framework on the basis of these basic assumptions. Revealing its basic assumptions might be important for increasing the acceptance and use of system dynamics. It will be shown here that mainstream system dynamics corresponds well with critical pluralism, that other approaches are more postpositivist, pragmatist or constructivist, and that still other (non-existent) paradigmatic approaches might potentially be interesting. The classification framework might be used furhtermore to find (i)

approaches that suit issues, circumstances, parties involved and goals, (ii) the basic assumptions of different approaches and hence the interpretation and use of the results, and (iii) consistent matches and mixes of system dynamics approaches with other method(ologie)s.

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Future of Forestry Employment in Indonesia

United Nations's Millennium Development Goals target improving environmental sustainability and alleviating extreem poverty. However, relationship between employment and forestry development is unclear especially when it deals with illegal forestry activities. This study aimed at generating projection of the forestry in Indonesia and developing various policy scenarios to decrease unemployment and improve environmental sustainability. The study observed components of natural forest, logging, forest plantation, wood-based industries and trade. The study used systems dynamic to implement the model of interaction among forest structure industries, actors and their institutions. The study found that the current practice of forest management would experience with growth and collapse of employment. Massive forest planting may jeopardize the employment and community's livelihoods if it is done inappropriately. Land tenure reform can boost the employment to meet the overall government of Indonesia target on unemployment level of 5.11% in year 2009.

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Adapting Group Model Building Methods to Improve Information Security Data

Cyber security data restrictions, e.g. due to fear of bad publicity, hinder systematic investigation of information security issues. We argue that group model building is a promising method to help mitigate such restrictions: 1) Models emerge from even incomplete and inaccurate data; 2) group model building helps develop a trustful relationship between data owners (clients) and modelers; 3) the iterative nature of group model building leads to increasingly structurally richer and more useful models, thus boosting further client interest and trust. We describe our experiences using a case for the transition to eOperations in the oil and gas industry. We analyze the outcome of two group model building workshops, the follow-up meetings and interview. We show the trajectory for how we gain access to data, how we developed and improve a model, what insights the client learned, and more important, how we build up trust with the client during this process.

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Simulation-based Learning Environments in Service of Dynmaic Decision Making

This paper asserts that system dynamic based leaning environment could provide an effective decision support and leaning in complex dynamic task. Experimental research on dynamic decision making and learning in computer simulation-based interactive learning environments is analyzed. A conceptual model encompassing key elements of decision making is

constructed. Departing from the traditional dynamic decision-making research focus on how poorly subjects perform in dynamic tasks, our model attempts to increase our understanding of the way in which expertise on dynamic decision making are acquired.

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Estimation, Prediction and Policy Design for Population and Universal Primary Education in Pakistan

The positive relationship between education and sustainable economic development is now widely recognized. This study develops a dynamic model for population and primary education of Pakistan. Primary education sector in Pakistan is operating in both public and private sectors. Pakistan has a clear socio-economic division of rural and urban areas that get different priorities in allocations of public funds, believed to be instrumental for universal primary education. The public financial allocations are available to some extent from different publicly available sources but that too on country basis and not on area basis. On the other hand, there is no data available for private sector investment. Based on its assumptions this study estimates area-wise public and private sector investment in primary education in Pakistan, predicts development path of its population and literacy, and suggests financial policy to meet the challenge faced by Pakistan to achieve universal primary education by 2015.

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Assessing Risks of Policies to Patch Software Vulnerabilities

The number of security vulnerabilities, breaches and digital disaster increases over time. One important source of weaknesses of computer networks are the ubiquitous flaws ('bugs') in the software, and most such bugs are exploitable by malicious agents. Consequently, "patching" the software to correct known bugs is becoming more important, especially for network-based system companies. However, this issue is often seen by decision-makers differently, due to the presumption that security measures are time consuming and a disturbance for the primary business activities. In addition, it is considered too costly to invest in prevention of something that might not happen. Patching often requires extensive testing and that computer networks be taken down. This work is a preliminary effort to build a system dynamics model for studying the trade offs and the risks of different patching policies.

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The Circular and Cumulative Structure of Administered Pricing

The purpose of this paper is to report on the administered pricing sub-sector of a Post Keynesian-Institutionalist-System Dynamics (PKI-SD) "core" model that is currently under development by the authors. When

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complete, the model will be used to examine the dynamics of heterodox economic theory, as well as to test the implications of heterodox policy alternatives.

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Professor Pasinetti, the Trend & the Cycle

In 1962, Luigi Pasinetti published a model of the "Cambridge theory of income distribution" that corrected a "logical slip" in Nicholas Kaldor's earlier formulation of the problem. Pasinetti's model included two stocks of capital instead of one, avoided Kaldor's assumption that the workers' marginal propensity to save was zero, and demonstrated that on a balanced growth path the rate of profit depends only on the growth rate of the labor force and the capitalists' marginal propensity to save (the "Pasinetti theorem"). Pasinetti examined the multiplier-accelerator family of models and concluded that they were unable to endogenously explain the interaction of the trend and the cycle due to their aggregate character. The purpose of this paper is to extend Pasinetti's 1962 model by adding a behavioral entrepreneurial expectations formulation to its structure. The extended model generates an interacting trend and cycle and closely mimics U.S. macroeconomic data. Full Information Maximum Likelihood estimation with Optimal Filtering (FIMLOF) is used to estimate the model's behavioral parameters, some of which evolve over time. These results add value to the debate about the causes of the interaction between the trend and the cycle and serve to blend ideas from Pasinetti's two papers.

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System Dynamics Modelling as a Tool in Healthcare Planning

This paper looks at the use of a System Dynamics model to support the development of a strategy to address diabetes in Manukau, a large multi-cultural city sitting on the southern border of New Zealand's largest city, Auckland. The paper describes the development of the model, from a simple, high-level conceptual framework to a computer simulation used to test a range of policy scenarios. As part of a major project undertaken by the Counties Manukau District Health Board, the model was developed with a team comprising clinicians across the spectrum from public health, through primary and secondary care. The model has been useful to inform thinking and develop a broader, system-wide understanding of diabetes and the strategies needed to address it.

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Exploring the role of design in the performance of SME's in the New Zealand furniture industry

The New Zealand furniture industry is having to cope, like many industries in small countries, with the opening up of world markets. The

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country as a whole - and the furniture industry in particular - is looking to design as an effective tool to help in meeting this challenge. However, there is little shared understanding between the design profession and small business owners, and even less by either group of the business models within which design is expected to contribute. This paper describes the use of visualisation techniques within the New Zealand furniture industry to help articulate the business model and do so in a way that makes much more explicit the roles that design could play. The purpose of these visualisations is to support dialogue between business owners and designers.

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Concept Models

Working with groups unfamiliar with system dynamics, modelers need a quick way to introduce the iconography of the approach and some of its framing assumptions. In the early exploratory days of group model building interventions at the University at Albany, we settled on the use of sequences of tiny models for this purpose, which we call "concept" models. The intent is to begin with a sequence of simulatable pictures so simple and self-explanatory, in the domain and language of the group's problem, that the group is quickly and naturally drawn into the system dynamics approach. Previous papers have sketched in passing the notion of concept models as we have used them. Here we provide a number of illustrative examples and describe in detail the ways we use these little models, the assumptions behind them, some design principles that have matured over time as our experience has grown, and a discussion of possible problems with the approach.

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High Point or Hobgoblin? Consistency and Performance in Organizations

Max Weber's argument that organizations benefit when they operate consistently and Robert Merton's counter-point that consistency arises from organizational dysfunction create a fundamental tension in organization theory. Substantial research has examined the spread of bureaucracy and organizational practices, while other research has examined how organizational change affects survival, but there has been surprisingly little research on the value or dysfunctional nature of ongoing consistency in following rules for decision making. This paper develops measures based on the definition of consistency as close adherence over time to a set of simple rules for conducting business. We explore the sources of consistency and test whether greater consistency is a beneficial high point in organizational development or, instead, whether consistency simply reflects Emerson's notion of a "hobgoblin of little minds".

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The Dynamics of Innovation in Networks: Analyzing Product and Technology Process for Market Complexes

Dynamics of markets are even today not adequately represented in most market studies so that yet nowadays, wrong conclusions are quite common. A good tool for analyzing markets and its dynamic character is the coordination failure diagnostics concept (cfd-concept) which is based on the idea of control loops on the one hand and economic literature of competition on the other hand. Regarding innovations, it takes a closer look at product and technology progress which are core tasks to assure the survival of markets – or, to be exact, products. Nevertheless, even in this concept the direct influence of up- and downstream markets was ignored so far, although it seems to be obvious that innovations stimulate new innovations itself – they might occur on the same or on related markets. First thoughts of analyzing market complexes with the help of cfd and system dynamics are to be introduced in this article.

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An Evaluation of Healthcare Policy in Immunisation Coverage in Uganda

This paper presents initial results from field work on immunization coverage as part of improving health care policy implementation in Uganda. System Dynamics modeling and case study research methods have been used to capture the complex and dynamic nature of the immunization process, to enhance the understanding of the immunization health care problems and to generate insights that may increase the immunization coverage effectiveness. Field studies have been conducted to establish the operational immunization policy issues of concern to health care management which included capturing reference modes for the key variables and developing causal loop diagrams to illustrate the dynamics among key variables. The paper suggests an initial model that could be used for theory building in immunization policy evaluation.

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A Concept of Resilience in Production Systems

The article presents the results of ongoing research on resilience in production systems. It refers to the term resilience as used in socio-ecological systems and applies it to assess the long-term functionality and effectiveness of industrial organizations in an uncertain world. It concentrates on refineries and chemical plants which, due to complex and sophisticated production processes and products themselves, are especially vulnerable to various kinds of disturbances. To illustrate the idea of resilience the machine reliability improvement programmes are examined using System Dynamics models to investigate situations when internal or external stress can lead to regime shift in production systems

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and make them move to an undesirable configuration e.g. from proactive to reactive maintenance mode. Resilience proved to be a useful concept for production managers interested in organizational transition to a more desired operational domain as well as remaining in the desired domain. System Dynamics methodology offers powerful tools for examining the impacts of various policy options on the dynamics of resilience in production systems.

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Controlling primary income distribution and employment under increasing returns

This paper demonstrates that the Kennedy – Goodwin macroeconomic model of capital accumulation (KGM) does not reflect direct increasing return. The author presents its two versions: KGM-I with weakening roundabout increasing return and KGM-II with reinforcing roundabout increasing return. Both have the common intensive form and same asymptotically stable stationary state. KGM-II is changed to allow for direct increasing return to scale, whereby the growth rate of employment ratio positively influences the growth rate of labour productivity. If the latter effect is strong enough, the dynamic equilibrium is locally repelling and bifurcates into closed orbits. Their period is estimated. This paper supposes a closed loop control that stabilizes the oscillatory dynamics of the main macroeconomic variables, main-taining profitability and employment under direct and roundabout increasing returns. It is proved that the supposed policy would be destabilizing if the direct scale effect were power-fully negative that is not supported empirically. Simulation runs maintain analytical findings. This paper yields insights for public debate on competent pro-growth stabilization policy. Key words: growth cycle, primary income distribution, employment, stabilization policy.

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Modeling E-Material Supply Chain

This study presents a system dynamics framework to model the Information Technology Institute (ITI) e-material supply chain as a case study of digital product supply chain. This e-material supply chain serves a foundation of providing e-learning programs. The aim of this study is to understand the dynamic structure of this e-material supply chain and hence suggest and evaluate possible policies to enhance its current performance. The first section is an overview of the e-material supply chain. The second defines the problem with the ITI e-material supply chain. The third section is for literature review. The fourth describes the model and the fifth discuss the model behavior. A list of suggested policies is evaluated to increase the e-material supply chain performance and decrease the associated costs in the sixth section. In the last section we conclude.

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Training Egyptian Middle Management On System Dynamics

This paper presents our experience in training middle managers from Egyptian Governmental organizations on system dynamics (SD) as a part of the Egyptian educational organizations efforts to increase managerial skills and raise business viability. A step-by-step feedback-teaching method is employed. We prepare a module of the material; teach it on a small sample to get feedback to further enhance the quality of the material developed. The paper starts with a discussion on the need for this course. It then gives a brief on the "Innovations in Professional Training in Egypt" project funded by Tempus Programme. The paper discusses the course preparation process and the students' feedback regarding the system dynamic education offered.

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Eigenvalue Analysis of System Dynamics Models: Another Perspective

The previous work related to eigenvalue analysis in the system dynamics field, focused on linking the model structure to the modes of behavior -- i.e. the eigenvalues. While the system eigenvalues define the characteristics of the system's behavior modes (e.g., exponential growth, expanding oscillations), these behavior modes are not equally represented in all model variables, making it difficult to link the behavior of the reference mode to the behavior of a particular variable. In this study we propose an alternative perspective and explicitly explore the significance that each behavior mode has on the system state variables. We achieve this by decomposing the behavior of a variable into a sum of the weighted reference modes in the system (represented by the eigenvalues). We argue that focusing on the weights, rather than on the eigenvalues, is a more efficient way to develop policy recommendations and compute the elasticity of the weights to the gain on any link the model allowing for a more efficient and discriminate way to identify policies. A routine to estimate the weights of any linear model and compute the elasticity of those weights to model links is developed and made available at http:// iops.tamu.edu/faculty/roliva/research/sd/.

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Exploring Patterns of Process Improvement with a Generic Model

Building upon previous work in the field of system dynamics, a generic model of multiple improvement initiatives is outlined. The current model structure incorporates empirical data gathered by the author. The empirical data is taken from a large international survey of manufacturing plants and serves as calibration sets for several program implementation patterns. Statistical analyses and simulation experiments revealed noticeable preliminary results: (i) plants should strive for balanced implementation patterns that focus on multiple programs instead of favoring a single program. (ii) Plants should balance their implementation patterns according to the organizational and technological complexity of the improvement programs, i.e. that comparatively more efforts should be spent on more challenging improvement efforts. The value of the conducted approach lies (i) in the explicit investigation of the impact of different improvement programs (e.g. TQM, TPM, process automation, training) and (ii) in the integration of empirically gathered data.

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Learning from Loops - Applying CLD to Identify Leverage Points as Organizational Learning

In this paper submitted to the special session on "System Dynamics and Organizational Learning: purposes, practices and pitfalls", we describe a system dynamics intervention using the principles of Group Model Building to uncover the deep-seated issues in a long-standing problem area of an organization. In describing this intervention, we will outline how we used causal loop diagrams to represent the system in focus and identify leverage points for improvement. This intervention is positioned as part of an organizational capability-building program involving a university postgraduate degree. This paper will analyse our learning in the context of the research question outlined in the special session proposal.

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Verifying System Dynamics Simulation Results by Analytical Phase Plane Tools

System dynamic models are typically impossible to solve analytically and even hard to correctly simulate. This complexity is also true in equilibrium and stability analysis. This research deals with analytical and numerical phase plane analysis of such models. Example models chosen have no analytical time trajectory solutions; they are nonlinear and computationally stiff. In the study, two example models are analyzed; a

prey-predator model and a competition model. Numerical phase plane constructions of these systems are first carried out. Then, analytical phase trajectories are obtained by using LambertW functions, implemented by Maple software. Numerical work is carried out by Stella simulation software, and by numerical algorithms in MAPLE. Comparisons between analytical and numerical phase trajectories are made and it is observed that significant discrepancies may exist. The study shows that, although analytical time trajectories are typically impossible to obtain, analytical phase trajectories offer important potential for system dynamics.

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Modeling Security Management of Information Systems: Analysis of a Ongoing Practical Case

How long could an organization survive without its information systems working efficiently? Frequent changes of the systems to protect, significant delays between efforts and results, the large amount of involved variables and the difficulty to measure some of them make security management a challenge for current companies. Simulation models provide a virtual environment that can help analysing the dynamic balance between the affected key factors. These key factors include technical controls (Software and hardware elements to protect the system), formal controls (Procedures for guaranteeing an efficient use of technical controls) and security culture (Human factors that affect the compliance of the designed procedures).This paper presents a real modelling process, involving a university team and two companies. The paper includes information about the used methodology, the process and the preliminary results of the obtained model. This process has allowed concluding that the obtained benefits are very promising.

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KEYNEO – a KEYnesian and NEOclassical model

The aim of the System Dynamics Model KEYNEO is to model the German economy over a long time period (40 years). Keynesian and neoclassical elements form the base of KEYNEO. In the first step a complex feedback structure was developed to model the main economic variables on an aggregate level. The equations for the supply and the demand side of the economy were defined in the second step. The results of different runs demonstrate that KEYNEO mimics historic data quite good. With the use of optimization tools the parameters could be estimated. The statistical analysis of KEYNEO shows that the results are highly significant. This verification underlines the quality of KEYNEO to model an economy. In addition, the structure of KEYNEO may serve as input for much more sophisticated models.

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The conception of feedback loops in econometric models, general equilibrium and system dynamics models

In practice for the treatment of macro-economic questions more frequently other methods than System Dynamics are consulted. Among the most important methods are the econometrics and the equilibrium modelling. Therefore it seems necessary to draw a comparison between these three methods. In order to accomplish the comparison of methods from a System Dynamics perspective, the following procedure is chosen: a model of each method is integrated in System Dynamics. Econometric models are also characterised by feedbacks - mostly positive -. However these are not considered as central element in the model building process, but they result implicitly. The comparison between equilibrium modelling and System Dynamics is seldom. Each individual (equilibrium) market can be described as negative feedback. Therefore there are many negative feedbacks in an equilibrium model. The results inform about the differences and demonstrate, how other methods could contribute to the development and founding of System Dynamics.

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Modeling and calibration of large scale system dynamics models: the case of the ASTRA model

Though the size of System Dynamics models should be compact focusing on the main feedback loops determining system behavior one kind of model can become quite large: multi-national, multi-sectoral spatially differentiated models. The paper briefly presents such a model called ASTRA (=Assessment of Transport Strategies), which is developed in several versions over the past eight years. The purpose of the paper is to describe an approach how such a system dynamics model despite its size can be calibrated to make it applicable for Europeanwide policy analysis of transport policies. The approach is designed as a sequential process involving an au-tomated tool combining a C-coded steering programme with the Vensim® optimizer to enable calibration of large numbers of similar equations that only differ by their pa-rametrization.

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LaTina – An online system for teaching and learning stock-and-flow thinking skills

This paper continues a line of work that took up previously published stock-and-flow thinking studies and proposed to apply the model of implicit learning to the case. According to this model, novices have to elaborate personal experience by following rules. After previous trials, a set of such rules is proposed together with a group of challenges that allow to apply and to learn them. A conceptual model for representing the rules, the challenges, the learners and their learning itinerary are proposed. Then, the design for an on-line system for publishing and

working with challenges and to monitor progresses is introduced. This software system is currently under construction and first data from its use will be presented at the conference.

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Modifying the Beer Game to make its dynamic structure more salient

This paper suggests that the misperception of feedback individuals show may depend on the frame presented to them. A brief summary of Kahneman's work about heuristics is used to argue that the Beer Game may not be neutral: its very presentation may influence the cognitive processes and the observed performance. Some modifications to the Beer Game material and rules are proposed in order to make the feedback and delay structure more easy to grasp. Empirical work with the modified material is currently in progress.

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An Exploration of Competition and Cooperation Through a Multi-Agent Dynamic-Game Model of Fishery Management

The interaction between economic and ecological dynamic systems is analyzed with a multi-agent dynamic game of fishery management. Multiple actors (fishermen) harvest multiple fish types and adapt the amount and allocation of their investments to their value functions, which are given as net profits of the fish harvest sold for a market price. We introduce and compare two different decision rules in the competition of fishermen which both lead to a decline of fish stocks as well as profits for most fishermen. As an alternative, we introduce a cooperative approach to jointly set sustainable limits for total harvest and investment that are then distributed to the fishermen according to distribution rules. As the simulation shows, fish stocks and profits stabilize at significantly higher levels in the cooperative case, leading to a continuous accumulation of capital.

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Traffic Shifts in a Comprehensive Truck Toll System, A Real-World Multi-Agent Based Simulation Case Study

As part of a project which deals with comprehensive free-flow toll systems for trucks and buses, a multi- agent based simulation model was developed. This model is used here to discuss the general development process for multi-agent based simulations which map real-world situations and whose results are the foundation for real-world decisions. It will be demonstrated that developing such models is a demanding task, requiring detailed understanding of the relevant reality and meticulous work. In addition findings from the model and their implication for planning and installing real world comprehensive truck toll systems will be outlined.

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Strategic Decisions in the Transition to Deregulated Markets

Liberalisation of markets is supposed to be an adequate procedure to satisfy the worldwide demand for innovations. However, the transition from regulated markets to competition is a disequilibrium phenomenon and requires specific consideration of the appearing dynamics. We present in this paper a simple, yet general, model which is instrumental in understanding the likely market evolution during a liberalisation process. Furthermore, the developed System Dynamics-based model provides the possibility to simulate strategic decision-making in out-of-equilibrium markets caused by deregulation. The impacts on firm and market performance of a price-maker strategy, enabled through process innovation, on the one hand and a differentiation strategy on the other hand are discussed in details. The model is adapted to a goods market, albeit the presented implications have much wider use.

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The Supply Net Game

The paper describes a game called, the supply net game, built around the structure of a production supply network based on the "anchoring and adjustment heuristic" which is known as the one people use to make inferences about uncertain events. The game involves four players where everyone manages his manufacturing unit that consists of four production lines which proceed to the joint development of products with the other units. While planning production and controlling inventories, every person should try to minimize the costs caused by both holding items on stock and being in an out-of stock situation. The paper stresses the valuable impact and contribution of management games for management and engineering education in general and particularly the significance of learning implicit skills as well as gaining insight in inventory control and management of complex distributed production systems such as the system dynamics production network model introduced and analyzed in the paper. The game will be used later in a controlled experiment which is not under the scope of this paper.

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GAIM (Gestione Accoglienza IMmigrati): A System Dynamics Model for Immigration "housing" Management

An immigration reception "house" which has the aim to deal with both first aid problems (food and bed) and health and social needs (medical and social services) involves many variables with a high level of interaction, hence a complex system. In order to manage such an infrastructure which can host a limited number of immigrants with different type of characteristics (Status – single(male/female), part of a family,…; Geographic provenience- Europe, Africa, Asia, …; Religion- Christian, Moslem, …; …) offering a selected number of services is not

an easy job.On the base of a enlarged project sponsored by the department of social activities of Lazio Region (the region which includes Rome city) aiming to train and supply tools to a number of intercultural mediators a system dynamics model has been developed both to analyse and better understand the overall immigration reception process and to create a sort of "flight simulator" in order to evaluate, in advance, some decision effects over possible scenarios.The paper will describe both the structure of the model which has been developed to embed, as much as possible, the whole process and a set of results produced in reply of a set of what-if analysis.

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From Individualistic to Collective Rationality in Simulation Games for Social Sustainability

This article presents the problem related to the sustainability of natural resources, in particular the common-pool resources, approached from the System Dynamics perspective and Collective Action Theory. It is stated that the rationality that makes cooperation possible among individuals is shared by these two research fields, and it is presented in this document as the fundamental source to propose preliminary orientations to design simulation games that foster a sustainable use of resources by means of the strategies that make cooperation possible.

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Investigation of pricing impact on the energy consumption behavior of the household sector by a system dynamics model

In this paper, a system dynamics model is developed to show how the changes in electricity price affect consumption pattern of the household sector in Iran. Electricity is a kind of commodity that is very difficult and expensive to be stored, if not impossible. It means that energy supply must always meet the demand. In addition, electricity supply capacity must be at least equal to the peak demand. Therefore, in non-peak hours, a portion of the capacity is not used. Peak shifting (shaving) is one of the demand-side load management techniques that can help such a problem. Moreover, subsidized electricity prices cause the power network to be overloaded in many hours of a day. This research has employed the system dynamics methodology, to analyze structure of consumption in household sector. First, the sector is divided into three income groups, including Low-income, Medium-income and High-income. Then, load pattern of each group is modeled by a bottom-up method, which is based on a fuzzy approach. The proposed model facilitates to investigate how different pricing and subsidizing scenarios can affect the consumption pattern to reshape it by shifting peak hours and/or reducing total consumption.

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The Dynamics of Innovation in Electronic Networks - a System Dynamics Perspective on Sustainable IT Innovation

This paper analyses IT innovation diffusion within communities joined through electronic networks. We draw on qualitative system dynamics, as a methodology of structure and behaviour, in order to understand sustainable IT innovation. The focal point of interest is the adoption-diffusion continuum, from prior use to post-adoptive behaviour, analysed and modelled by means of "adaptive structuration" based on "duality of structure". We draw upon the structurationist system dynamics approach (Reichel A. 2004) and extend it within the context of IT innovation in electronic networks. The aim is to begin the development of an integrative modelling base for IT innovation sustainable diffusion. "Cognitive model building", and "information processing", are secondary (supporting) epistemic levels, used to aid clarifying issues of collective sociality and group outcomes in innovation uptake. The endeavour undertaken ventures on a holistic route of thought, with the emphasis shift from pure subjectivism to "structuration", moving beyond "intention" toward a system dynamics analysis of IT innovation.

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Simulating impacts of disruption in a network of chemical manufacturing plants and supporting infrastructures

In our study, we looked at how the impact of disruptions may be modelled in a network of chemical manufacturing plants. Given that the number of plants involved is large, it is not time-feasible to model the operation of each plant in detail. However, after 1st round of quick analysis, we can selectively model the identified critical components in greater detail. Hence, the challenge is to develop a standard template that can capture sufficient information about a plant, to give meaningful result. The standard template can be applied to all plants in our study and also allows a non-technical user to easily represent a new plant and integrate into the existing model.

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Cobweb Model in System Dynamics Form - Hyperincursive Perspective

The cobweb model of competitive market dynamics has been examined in the form of system dynamics model. Separation of the structure

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elements and introduction of anticipative hyperincursive algorithm was used for transformation of the classical cobweb model to the accelerator based one. The cyclical response of the system that depends on the demand~supply parameters and eigenvalues of the characteristic equation has been numerically examined. The concept of parameter differentiation and time response of the system is transformed to the periodicity concept where periodicity is the main, driven property of the model. As such this is the key attribute in complex discrete agent-based adaptive anticipatory models. The periodic conditions of the model have been analytically determined by the application of z-transform. The periodicity conditions of the initial map have been preserved in the nonlinear case. By the application of the Lyapunov exponents several stability regions of the nonlinear model were numerically determined.

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Sustainable Management of Shrimp Farming: A Case Study in Ninh Thuan, Vietnam

Here, a systems dynamics approach combines the environmental, economic and social aspects of intensive shrimp farming to construct a sustainability forecast. Intensive shrimp farming threatens to cause irreversible damage to water and land resources. High initial investments required are risky to small start-up farmers as ponds are prone to self contamination within a few years. This study is based in Ninh Thuan, one of the poorest regions in Vietnam. Since 1999, local people started to turn to intensive shrimp farming for quick profits. Causal loop diagrams presented focus on the individual shrimp farms and their collective effect at the municipal level. Modelling on the environmental aspect indicates that the current practice of intensive shrimp farming is not sustainable for Ninh Thuan. A combination of lowered stocking densities, pond cleaning and limitation on the land area converted to shrimp ponds will be beneficial for the local community in the long term.

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Feedback Processes in Economic Growth: Relations between Hours Worked and Labour Productivity

This paper analyses different feedback processes arising from physical and human capital accumulation as well as from technological change, which are considered general factors to promote the growth in any economy by economic literature. A dynamic system is constructed to explain the relative influence of these factors on the rate of economic growth in a generic economy. The development of the model requires to analyse different interactions among variables linked to decisions of the agents that participate in the economy, particularly certain variables associated to the labour market are examined. Using a system dynamics

simulation the conditions under which a smaller number of hours devoted to the labour market could imply a greater labour productivity are characterized.

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Lessons from LUTAQ: Building systems thinking capacity into land use, transportation, and air quality planning in Las Vegas, NV

This paper reports on the culmination of a two year project to facilitate "smart growth" planning in the Las Vegas, Nevada metropolitan area. Using a group model building process, representatives of key municipal entities and resource management agencies developed a model for examining the potential effects of changes in land use and transportation planning on air quality, traffic congestion, and other quality of life factors. The model and the process both contributed significantly to broadening systems thinking capacity in regional planning. The model supports system-based policy evaluation and the process created a common systems language among the more than 20 land use, transportation, and air quality planners in the group. The model represents regional links between population, transportation infrastructure, land use characteristics, and air pollution. Model analysis shows that the most powerful tool for achieving policy objectives is a combination of land use design and transportation infrastructure that reduces the average number of trips per day and distance per trip. This paper describes the model, results of the analysis, and effects of the group model building process on the participants.

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"Campaigns are Like Crack" Organizational Addiction to Sales Promotions

We describe a model-based field study of a large financial services firm. Each region and branch in the retail banking division strives to meet sales targets for each product category (e.g., checking, home equity, etc.). The Bank runs periodic campaigns during which staff work aggressively to sell particular products and receive financial bonuses for doing so. Campaigns are intended to boost sales and provide concentrated learning experiences that accelerate skill development. Evidence shows that campaigns have many of their intended benefits. However, campaigns also generate a range of harmful unintended consequences, including: employee burnout and turnover; congestion in back office operations; lower sales quality (e.g., selling to customers with lower credit ratings); corner-cutting (e.g., not taking time to learn about customer's needs); and lower sales of other products. Thus campaigns improve short-run performance at the expense of long-run organizational capabilities, triggering pressure for still more campaigns. The organization becomes addicted to campaigns as its underlying capabilities erode. We document these dynamics and the feedback structures that generate them through a field study using extensive interviews and quantitative data. We close with policy implications and describe experiments designed to verify these hypotheses and interventions to improve performance.

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Identifying challenges for sustained adoption of alternative fuel vehicles and infrastructure

This paper develops a dynamic, behavioral model with explicit spatial structure to explore the co-evolutionary dynamics between infrastructure supply and vehicle demand. These "chicken-egg" dynamics are fundamental to the emergence of a self-sustaining alternative fuel vehicle market, but not well understood. The paper explores in depth the dynamics resulting from local demand-supply interactions with strategically locating fuel-station entrants. We examine dynamics under heterogeneous socio-economic/demographic conditions. The research reveals the formation of urban adoption clusters as an important mechanism for early market formation. However, while locally speeding diffusion, these same micro-mechanisms can obstruct the emergence of a large sustaining market. Several other feedbacks that significantly influence dynamics, from both supply and demand behaviors are discussed. This can find applications in developing targeted entrance strategies for alternative fuel in transportation. The roles of other powerful positive feedbacks arising from scale and scope economies, R&D, learning by doing, driver experience, and word of mouth are discussed.

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Modeling the Spatial Co-Evolutionary Dynamics of Hydrogen Vehicles and Refueling Stations

Diffusion of alternative fuel vehicles is both enabled and constrained by the interplay of powerful positive feedbacks arising from scale and scope economies, R&D, learning by doing, driver experience, word of mouth, and complementary resources such as fueling infrastructure. This poster describes an initial modeling effort focusing on the co-evolutionary dynamics between vehicle demand and fueling infrastructure. The model simulates both dynamically and spatially the interplay between consumer vehicle purchases and driving behavior and the development of a supporting refueling infrastructure. We reveal the formation of adoption clusters in urban areas as an important mechanism for early adoption, while, on the other hand, these local clusters are also an impediment to large-scale and sustained market formation. Expanding the model boundary to include other relevant dynamics, which would slow the technology diffusion, would enhance our ability to assess various transition strategies and policies.

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Alternative fuel vehicles turning the corner? A product lifecycle model with heterogeneous technologies

The automotive industry is on the verge of a technological disruption as more and different alternative fuel vehicles are expected to enter the market soon. Several questions come up for the many who contemplate on the next “standard”. However, industry evolution theories are not

unified under what conditions entrant technologies can be successful. Technology transitions are dynamically complex, because of the interdependency of delays in return from R&D efforts, the intertemporal character of learning, investment commitment, technology spillovers, scale economies and other barriers to entry, replacement dynamics, consumer choice behavior, uncertainty in technology valuation, heterogeneity in technologies, and various sources of organizational inertia. This paper introduces a semi-durable goods product life cycle model, with explicit and endogenous technology heterogeneity, product innovation, learning-by-doing investment decisions, and spillovers between the technologies. While motivated by, and its dynamics are discussed in relation to the automobile industry, the model is general in the sense that it can be calibrated for different industries with specific market-, technology-, and organizational characteristics. We explore its dynamics and discuss implications.

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Evaluation of Water Supply Project with Quantitative Model Building

Evaluation of ODA: Official Development Aids project and programs including the infrastructure development project or regional socio-economic development may play an important role in promoting further advancement of developing countries as well as accomplish a scale of accountability to taxpayers of donor countries. Quantitative models are commonly used during feasibility studies; however, it is not common to use quantitative models for evaluation, especially for an evaluation of ODA projects and programs. We attempt to apply SD/ST modeling for evaluation of ODA projects and programs to identify a special evaluation methodology. In this paper, we focus on evaluation of impact using quantitative model and examine water supply project funded by the Government of Japan.

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Modeling Serial Killer Development Theories

Growing interest in serial killers topic we face started two years ago by two cases that shake up public view of this phenomenon in Czech Republic. Serial killer behavior used to be very rare in the country. The only contact of the society was an old case from 50´s and later just the Hollywood production represented by the “Silence of the lambs” movie. Two cases in two years raised both expert and public discussion only to discover that there are mostly emotions on the side of public and non-acquaintance on the side of professionals. A forensic psychiatry chapter of the Purkyne’s Medical Society declared interest in dynamic models of the serial homicide behavior (psychobiological and-or psychosocial) and this paper describes the process of its construction.

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A Dynamic Approach to Vulnerability and Risk Analysis of the Transition to eOperations

To reduce costs (by ca. 30%), increase production (by ca. 10%) and

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extend the life time (by ca. 5 years) of North Sea wells the Norwegian oil & gas industry is developing an infrastructure of "integrated operations" – i.e. eOperations from control centers with reduced personnel on offshore platforms. New technology, new work processes and new knowledge are needed. Increased reliance on information technology introduces risks, with components of threat, vulnerability, and impact depending on how the transition to eOperations is managed. Simulation models show that the risk behavior of the system depends sensitively on how resources for work process development and knowledge ac-quisition are deployed. Understanding such dynamics facilitates decision-making to minimize security (and safety) risks.

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Group Model Building Intervention in Developing Country: Lesson Learned from Developing Strategies for Clean Air

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This article uses the framework proposed by Rouwette et al. (2002) that has been tested by Stave (2005) to report group model building intervention of a project to develop vehicle emission reduction strategy in Jakarta, Indonesia. The project is among the first attempt that was conducted in the developing country to solve the public issue. Many rapidly developing countries exhibit a faster vehicle emission grows over time compare to those of developed world at comparable income per capita (Marcotulio et al., 2005:125). Consequently, the need to solve the problem under the economic restriction is pressing. The case supports the findings of Rouwette et al. (2002) regarding a strong connection between group model building and group learning about the problem. The group has not reached a consensus, as the participants who attended the final meeting were not broad enough. Nevertheless, the findings demonstrate a potential of the group model building intervention to build a consensus among stakeholders. The approach in setting up the workgroup needs a modification to enhance the stakeholders' participation throughout the meetings.

What We Don't Measure about Human Resources: Towards a Conceptual Framework for Analysing the Role of Soft Variables

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Low retention of valuable employees and difficulties in finding qualified candidates for recruitment are two issues managers face in Romania, but are a growing concern around the world (Deloitte, 2004; Holton & Naquin, 2004). High turnover of specialists disrupts organizational continuity (Lum, et al,1998) and the current policies don't seem to have the expected results, according to the field study of the author. We suspect that the cause of inefficient policies lies in a misperception of

dynamics, ignorance of feedback loops and of intangible stocks, like the job satisfaction of employees. Although well documented in psychology literature (Lichenstein, 1998),the influence of job satisfaction on turnover seems to be ignored by the policy makers. We test policies that account for the determinants of job satisfaction and show that the outcome of such policies is better than the current ones. Implications for HR policy design and directions for future research are indicated.

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Nomadic Beer Game on Computer Networks

Beer Game is one of famous business games. Indeed, it is played or learned in many universities, graduate schools, and company trainings. This game's original version requires a game board and some pieces which are substitutes for real beer boxes or bills in the original version. After that, computer versions have been already produced. The original version provides the learning environment with reality, and the computer version offers the self-learning environment. Nevertheless, facilitators still want additional improvements; this game should be easily installed, run quickly, provide a real competition environment and have no influence on installed computer. Thus, users expect "Nomadic Beer Game environment," because this game is used in a short period or part of one seminar. Existing software can partly meet such expectations. However, there is no software implemented whole these functions. This research project analysed Beer Game users' expectations and composed software meeting their needs is constructed.

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Stock Flow Diagram Making with Incomplete Information about Time Properties of Variables

Models for numerical simulations should be described in a coherent style. They are expected to have consistencies at the causal dependency level. However, System Dynamics causal loop diagrams can have inconsistencies. This diagram style's arrows, concerning flow and stock relationships, can have the opposite direction of stock flow diagrams which can numerically simulate models. These inconsistencies can cause inappropriate qualitative simulations so that it is sometimes recommended to use stock flow diagrams instead of causal loop diagrams even for qualitative simulations. However, causal loop diagrams have merits in their use. Causal loop diagrams are intuitively easy to draw and read. If causal loop diagrams are given information about each variable's dynamic property, they can be changed to stock flow diagrams and simulation models can be generated. This paper suggests how to use causal loop diagrams as a starting point in numerical simulation research.

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A Dynamic Analysis of Long Term Impacts of Genetically Modified Crops

To study the long-term usefulness of genetically-modified agriculture via herbicide-tolerant crops, a simulation model is built by focusing on the fundamental environmental feedback mechanisms. The most critical

mechanism is the evolution of resistance in weeds via natural selection. Agricultural sustainability is investigated under different policies and scenarios, in comparison with conventional crops under two herbicide strategies. In the first strategy, herbicide amount is a function of weed density; in the second it is constant. It is found that superweed emergence increases the rate of resistance evolution in weeds. Under the constant herbicide strategy, GM crop is more effective than the conventional crop. However, this strategy results in a higher rate of resistance development and more herbicide usage than the first strategy. In terms of long term cumulative yield losses, rate of resistance development and herbicide usage, the best policy is discovered to be planting conventional crops under variable herbicide strategy.

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Mapping the Paths to a Green World

Building off the qualitative work of Clapp and Dauvergne (2005), this paper creates a system map to integrate four competing mental models of economy-environment relationships—market liberals, institutionalists, bioenvironmentalists, and social greens. The map is constructed in piecemeal fashion beginning with perceived relationships between economic growth and environmental degradation. Additions to the map include parsimonious structures for international trade, foreign direct investment, and international finance. A high level of aggregation is used to show general behavior of global economy-environment system interactions.

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Making Sense Of U.S. Health Care System Dynamics

Complexity of organization and resulting dynamic behavior are prominent attributes of the U.S. health care system. These characteristics often compel analysts to deconstruct problems and take a piece-by-piece approach. However, such a piecewise approach may miss subtle and powerful interactions within the larger health care system structure. System dynamics methodology can be applied to identify and resolve issues arising in complex social systems such as health care. In a commercial managed care organization, a comprehensive system dynamics simulation model of the U.S. health care system helps users to make sense of systemic behavior and forecast key trends.

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Principles of Emergence. A Generic Framework of Firms as Agent-Based Complex Adaptive Systems

As competitive environments are becoming turbulent, management science is showing increasing interest in the concept of emergence. This concept is closely related to the "new science of complexity" and its

agent-based approach. While this agent-based approach of complexity science is on its way of becoming a new paradigm in management science, the system dynamics approach is suffering from a lack of management attention and impact, although both are being applied to similar problems with similar outcomes. In previous research, scholars have compared system dynamics modeling and agent-based modeling. This paper steps back from the modeling aspect and looks at the requisite conditions, as identified by complexity science, that make emergent phenomena happen. Complex adaptive systems are agent-based systems capable of balancing emergent efficiency and innovation without central control. In this paper we give a comprehensive overview of mechanisms and principles of complex adaptive systems that are prerequisites of emergent phenomena. We propose a generic framework of complex adaptive systems for use in management science. This framework then serves to assess exemplary literature on applications of complexity science to firms and to discuss research implications for both agent-based and system dynamics approaches to management problems.

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Reforming Mental Health Services in the UK - Using System Dynamics to support the change in depression services

This paper describes major reforms to mental health services in the UK over the past 50 years and analyses the significant reforms of the 1980s and 1990s. These involved moves towards a balanced, mixed community/institutional provision of services set within a range of significant reforms to the National Health Service. The major intended and unintended outcomes of the reforms are reported. A major aim of the paper is then to describe an alternative refinement to service provision. The alternative approach, known as 'stepped care' is described in the context of depression services in the North West of England, where it is currently being implemented to improve and simplify services. In particular, the paper describes the use of system dynamics modelling to overcome anticipated problems with stepped care, such as communication of benefits and resource reallocation. The modelling process provides an example of archetypal thinking in action to pre-empt and counter unintended consequences in parallel with the main reforms.

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Modeling the Communications Dimension of Clinical Work and Medication Errors

Hospital medication errors continue to be a significant problem despite the targeted use of information and communications technology (ICT) interventions. In an ongoing program to add an 'in silico' dimension to

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our multi-method multilevel evaluations we have modelled the significant role of communications in medication error at the context, process and task interaction levels. This extends our previous long-term context and process interaction system dynamics model and adds agent based modeling to more naturally represent the process and task interaction level. The conceptual model integrates previous relevant communications, work and organisational context, task interruption and cognitive overload modeling. The prime focus is to understand and integrate the multiple effects of ICT interventions at multiple levels that can combine to produce unintended results, including new errors. It is being extended to provide a high fidelity systems simulation testbed for designing and testing ICT interventions to reduce medication errors.
KEYWORDS: Hospital Medication Error, Communications, ICT, System Dynamics and Agent based modeling.

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Jeu-de-Joule: a conceptual earthly energy model

Present fuel prices trigger a renewed interest in the energy debate. The paper extends the debate beyond the present boundaries with a descriptive model that maps two parallel processes on earth: (1) the stocks & flows of energy, developing between the earth's main energy source: the sun, and its main energy sink: outer space, and (2) the accumulation of a collective memory on earth in the form of genetic information in living organisms (DNA), and in the increasing number of "Bytes" of information created by humans. The model makes it possible to "think through" the parallel developments of energy and information, and of the parallel growth of activities that goes with it. It also provides a tool to distinguish the stocks and flows of energy that drive the economic activities on earth. This may help the debate to go beyond the stage were all energy remains equated to non-renewable resources, just like it was equated to "horse power" in the past.

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Understanding and accelerating the diffusion process of energy-efficient buildings

This paper describes the innovative research approach of a project that has recently been funded by the Swiss National Science Foundation (SNF). The project aims at analyzing and accelerating managerial and organizational adaptation processes that foster the diffusion of pioneering energy efficient technologies in the building sector. Psychological, managerial, and economic theories as well as results of empirical investigations about antecedents of behavior choices will be synthesized into a simulation model for a middle-sized Swiss city. The model will shed light on dynamic interactions between behavioral factors (e.g., planning, decision making and routines of the relevant actors in the building sector) and contextual factors (e.g., technological innovations, public initiatives, and market conditions), thus explaining the diffusion of energy efficient buildings in a community. The objective of the paper is to discuss the chosen approach, to explore the nature of the topic and present first research heuristics.

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Punishing by Rewards: When the Performance Bell-curve Stops Working For You

Many organizations today use a bell-curve for performance evaluation process. They reward a small percentage of top performers, encourage a large majority in the middle to improve, and lay-off the bottom performers. Companies believe that such pay-for-performance system encourages employees to perform better. The question we explore in this paper is: does the system increase the overall performance of the company over time? We observe that pressure, if maintained below a certain level, can lead to higher performance. However, with lay-offs, constant pressure demoralizes employees, leading to drop in performance. As the company shrinks, the rigid distribution of bell-curve forces managers to label a high performer as a mediocre. A high performer, unmotivated by such artificial demotion, behaves like a mediocre. Further, managers begin to reward visible performance over the actual. Finally, the erosion of social capital could cripple the company. We recommend the use of a semi-bell-curve where someone who performers like a top performer is rewarded as one. Further, we recommend balancing pressure and morale. We recognize that such a balance is very difficult to strike, and can be successfully achieved only by decoupling to some extent the performance evaluation process from the issue of lay-offs.

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DANESS: a system dynamics code for the holistic assessment of nuclear energy system strategies

The assessment of nuclear energy systems asks for a modeling of the worldwide nuclear reactor park including all supply chain details, i.e. the nuclear fuel cycle, demands for an integrated nuclear energy system model which also includes feedback loops representing physical feedbacks within the system as well as, and most prominently, socio-political feedbacks in the decision-making on the various available

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deployment pathways for nuclear energy. Despite the availability since the early 1960s of detailed model-codes for nuclear reactors covering physic, supply chain and economic aspects of nuclear energy, development of a truly system dynamics view on nuclear energy development only recently gained worldwide interest. This paper will bring an overview on the role of nuclear fuel cycle centres which have recently regained interest in the light of a perceived growing importance of nuclear energy in the world's energy provision and the inherent proliferation concerns this might entail. Using the DANESS nuclear energy system dynamics code, ANL performs a comprehensive study on various nuclear energy deployment scenarios in six world-regions and the potential role that such regional nuclear fuel cycle centers may play in facilitating such nuclear development while respecting proliferation concerns. The paper will conclude by stressing the importance of a system dynamics perspective in addressing such nuclear energy system deployment scenarios.

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Evolutionary Effectiveness's Dynamics of Enterprise Innovation

The straggled, reactive and inertial orientation of Colombian entrepreneurship has been justified, inconsistently, for the hardness resources agency (internal and leveraged), concept that intensify the deficient technological capabilities being, because this situation only not become a technological means trouble, rather strategic purposes. In fact, a classical one effect of no conscientious recognition of this limitation, explain why so many organizations connect your successful with your "intelligence", but failure with exogenous factors impact. On this understanding and intervention level, this document illustrates 3 criterions of development: (1) integration for selection, (2) learning as absorption, and (3) innovation as evolutionary addressing, through which knowledge's constitutes as transversal action and organization principle, with 2 fundamental implications: (1) on theory help to comprehend the systemic determinants of innovation through knowledge structures; (2) on practice, an empirical analysis of this evolutionary system can help to insight focus areas for strategic stimulation of connections and synergies to better performance.

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A deterministic model to assess the impact of HAART in Sub-Saharan countries.An application to Botswana

Recently news about the severe acute respiratory syndrome (SARS) and avian flu viruses has caused significant panic in many countries. These viruses, for Europe still very much a theoretical danger obscure the much more immediate danger of the human immune deficiency virus/acquired immune deficiency syndrome (HIV/AIDS). We develop a deterministic compartmental simulation model to assess the impact of highly active antiretroviral therapy (HAART) and various other interventions (aimed at modifying behavior) in sub-Saharan countries. We calibrate this model

using data from Botswana. To our knowledge our model is the first to include all the important factors of the HIV/AIDS transmission. The model shows that HAART alone, at the current implementation level, cannot significantly impact the number of HIV/AIDS infected individuals in the long term. The association of HAART with the treatment of other sexually transmitted diseases (STDs) seems to be more promising and could cut the number of infected individuals by half by 2010.

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The System Dynamics of Group Facilitation and Communication

In this paper a theory of group facilitation and communication is introduced, based on the work of Gregory Bateson and the Palo Alto schools he founded and inspired. This theory permits an analysis of group facilitation processes on the basis of the same principles that inform system dynamic model building and simulation. Through this theory existing lists of appropriate facilitation skills and attitudes are elaborated and augmented. This leads to greater insight into the quality of the process of group model building and possible ways to evaluate that process. Ultimately, the growth and proliferation of system dynamic models and simulations depends on improvement of both process and content of modeling and simulation.

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Stochasticity in electricity markets : Combining system dynamics with financial economics

In this paper we combine a fairly complex system dynamics model of the Nord Pool power market with stochastic price models from financial economics. The idea is to combine the fundemantal relationships of a system dynamics model, with a good representation of stochasticity from stochastic price models. The purpose is to provide long-term price prognoses for investment decisions as an alternative to the current approach of using scenarios for long-term prices generated by fundamental, partial equilibrium models. Our paper describes a case study at Agder Energi, a Norwegian utility operating in the Nord Pool market.

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Market Dynamics for Decision Support in Marketing

This paper deals with issues related to a system dynamics modeling of market structures from a company's viewpoint. It is focused not only on a

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general system dynamics approach, but also on broader perspectives and aims - overcoming well known system dynamics market models, better intelligibility for marketing managers (e.g. in a form of using familiar marketing terms and market segmentation) and techniques of working with relevant data obtained from marketing research. For further analysis and modeling, three basic types of markets have been chosen – markets with fast moving consumer goods, durable-product markets, and services markets. Within the models, the authors want to reflect the structure of consumers according to demographics and their experience and knowledge of the product. Also relations between the value perceived by the consumers, product attributes and promotional activities are taken into account. Described by the authors, the market model will be one of the results of a project supported by the Czech Science Foundation grant "System Dynamics Theory and Market Structures", number 402/05/0502. The approach points out some positive aspects as well as the limits of system dynamics based on the author's own experience in practical applications of system dynamics models.

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Non-Standard Basic Monthly Earnings Calculations For Long-Term Disability Insurance Contracts: A System Dynamics Examination

A required feature of a Long-Term Disability (LTD) insurance policy is its method of calculating Basic Monthly Earnings (BME), which determines how much a disabled customer will be paid. Most BMEs conform to some standard formula. However, to increase sales of its LTD policies, a large U.S.-based LTD company increased its use of Non-Standard BMEs (NSBME), which led to more errors and higher costs. Our model tested various processing approaches and found the optimal way to process these claims: an even mix of low-level Disability Benefits Specialists (DBS) and mid-level Benefits Financial Consultants (BFC). The costs of the BFC review were offset by the savings from all the errors they detected. Also, suspecting that he company's reliance on NSBMEs was an example of the "Fixes that Fail" and "Shifting the Burden" systems archetypes, we found that eliminating this practice was the highest leverage policy of all.

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Studying the Dynamics of Organizational Stress in the Egyptian IT Sector

Work pressure perceived as acceptable by an individual, may even keep workers alert, motivated, able to work and learn, depending on the available resources and personal characteristics. However, when that pressure becomes excessive or otherwise unmanageable it leads to stress which will consequently damage workers' health and business performance. The main problem of this research is how to reach a healthy work environment where the pressures on employees are appropriate in relation to their abilities and resources, to the amount of control they have over their work, and to the support they receive from people who matter to them. The research aimed as well to explore what are the

different factors causing stress, the weight of each variable as well as the relation over time between each stressor and response behavior using the System Dynamic methodology. The most important conclusion was that Egyptian IT industry is one of the unique industries that showed that good performance under high levels of stress. This can be achieved if organizations successfully implemented stress management programs that provide employees with coping skills and techniques to use environmental resources and support.

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The Dynamics of Egyptian Information Technology Employees Turnover Intention

In this study, the researchers examine the dynamics turnover intention in the Egyptian Information Technology (IT) employees. The dynamic hypotheses and the key leverage loops showing the most important relation between turnover intention and its own influences such as job-hopping, perceived alternative employment opportunities and other variables have been developed. Scenario analysis, included the effect of demographics on turnover intention; effect of job satisfaction on organizational citizenship behavior, perceived alternative employment opportunities and turnover intention; effect of HR practices (procedural justice and distributive justice) on job satisfaction; the effect of job-hopping, organization citizenship behavior and perceived alternative employment opportunities on turnover intention and the effect of turnover intention on organization commitment and work effort, where the percentage of change was the used measure. The researcher analysis results revealed that Motivation, recognition and rewarding will have biggest influence in increasing job satisfaction and controlling turnover intention, while some other variables like age, gender and education did not significantly affect turnover intentions. Research results also showed that controlling turnover intention at lower level did not only increase retention but also did also influence employee's productivity as the organization citizenship behavior can be enhanced, organization commitment and lowered the work effort perception.

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Government Intervention Effect on Automotive Market Dynamics in Egypt

This research emphasizes the market response to any governmental intervention in terms of market total sales change, balance between CKD and CBU sales portions in the market, future of CKD business and its supporting industries. This research will also propose possible integrated policies –set of laws– that could be the way to stabilize the automotive market and develop the related industries in this important and potential cluster. After having the simulation model ready, several runs are conducted for validity check and scenarios of different opinions are examined. Output of these runs are subjected to comparative analysis to induce an optimum scenario, defining recommended values for governmentally controlled variables, and strategies behind these recommendations. In addition, the research defines the market segments which have the most potential for growth if encouraged, and consider

minimization of the potential harm that can affect the local industry, and therefore give it time to achieve technology and capital build up to be able to start competing.

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Analyzing the Dynamic Implications For Improving Hemodialysis Session Performance By System Dynamics Modeling

We present a framework system dynamics (simulation) model that evaluates the effect of dialysis policies on session performance, quantifying, optimizing dialysis efficiency and monitoring dialysis performance online. The model focuses on analyzing and highlights factors which may alter the delivered dose and may lead to session degradation such as reduction in treatment time, ineffective urea clearance due to access recirculation, inadequate blood flow to the dialyzer, dialyzer clotting, low blood pump and dialysate flow, or underestimates of flow due to calibration errors and blood pump tubing collapse that related to hemodialysis machine maintenance. Thus our second goal is to increase the overall equipment effectiveness which is extremely important in evaluation of adequacy of hemodialysis. Routine preventive and annual maintenance is vital to provide a safe and adequate dialysis and must be conducted with careful attention and in a timely fashion. Five blood samples were drawn from 134 dialysis patient; arterial sample at the inlet of the dialyzer, venous sample at the outlet of the dialyzer, peripheral sample, pre blood urea sample and post blood urea sample. The post blood urea sample was drawn at different dialysis times to validate the results of our dynamical model with the measured results.

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Mapping the Dynamic Effect of Customer Switching Costs Management on the Mobile Industry in Egypt

While literature have provided a great deal of insight into and understanding of switching costs, the researchers believe that important aspects can be improved and expanded upon to strengthen the conceptualization of the term in the appropriate context. The research discusses these aspects and then, building on the outcomes of the work done by Hess in Ricart (2002), concludes the theoretical framework with the respect to the Egyptian market context in terms of switching cost categories. The research try to map all possible attributes of the switching costs in order to be able to measure it's effect on deterring the customer from switching to competitors. For the purpose of testing and measuring the effect of different policy scenarios on customer experience dynamism, the researchers designed a simulation model using SFD. The validation phase was achieved through performing sensitivity analysis, subjecting the model to extreme conditions and reproducing the reference mode. After validating the model, the researchers designed the policy analysis runs and undertook different scenario analysis over a time span

of 12 month. Scenario analysis included studying the effect of elements such as Local Number Portability LNP, effect of potential entrant on the perceived customer's switching costs level.

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Towards Better Understanding of Software Testing Dynamics

In this paper the researchers attempt to address the complexity and dynamic behaviour of Software Testing Process. A lot of researches has been developed to address the complexity of software development (Abdel-Hamid and Madnick, 1991) using system dynamics models, from different perspectives. In this paper we are focusing on Testing Process Dynamics as key element in success of software projects. This paper also tries to stimulate testing professionals to make use of system dynamics for the testing process improvement instead of receiving ready to implement models from third party who doesn't have same deep understanding of their process. The reason for this is the number of details required to model any cycle which will include interactions between process, people as well as projects which makes it difficult and even not realistic to develop one model to reflect all these in all environments. That's why researchers are trying to encourage testing professionals to do the job on their own by providing a starting point for them to realize importance of system dynamics for their process improvement.

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Modelling the Glucose Regulatory Feedback System -- Understand the Mechanism Underlying Ultradian Oscillations

A system dynamics model for the glucose regulatory feedback system in human is used to understand the mechanisms underlying ultradian oscillations of insulin secretion and glucose levels. The model in this study shows that the Glucose-Insulin, Glucose-Glucagon and the Insulin-Glucagon feedback loops are significantly important to produce these oscillations. The model confirms that the occurrence and properties of the oscillations were found to be critically dependent on the two delays between the insulin concentration and the subsequent effect on glucose production and glucose utilization. Simulations conducted by researchers further suggested that the level of plasma insulin and insulin secretion pulses were significantly lower in diabetic patients due to the broken glucose-insulin and insulin-glucose feedback loops in those patients. The model was validated via several kinds of test inputs (glucose injections and infusions, insulin injections and infusions, etc.), and its behaviour was compared with the experimental data, in order to gain confidence that this model accurately represents the actual endocrine system.

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Carbon Emissions: Changing Minds - Changing Hearts

The Carbon Trust [www.carbontrust.co.uk] helps UK business and the public sector cut carbon emissions, and aids development of low carbon technologies. It needs to demonstrate its effectiveness so as to increase Government support. Although the Trust has much information on awareness and attitudes amongst its audience, it needs a clear and indisputable way to show how these cause changed investment rates in carbon reduction by their target organisations. This poster will demonstrate a strategic architecture and early model that link data on awareness and commitment amongst target executives, through investments in both improving carbon efficiency of existing business assets and replacement of assets with low-carbon alternatives, to the overall reduction in total carbon emissions. This requires not only the modeling of changes in audience awareness, attitudes and behaviour, but also the impact on these factors that arise from the Trust's spending on marketing, advisory services and technologies. The resulting model enables the Trust to assess and make its case for levels of spending on its activities and how that spending should be deployed.

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Voter's Power in Aging Societies

This paper elaborates the underestimated problem of voter's power. Recently the demographic change as a major topic came up on the agenda in industrialized countries. Therefore, societies nowadays also evaluate political actions on their consequences on aging. How can we diminish unfavorable outcomes of ageing? The authors of this paper would like to draw the attention on a different perspective. If societies getting older and suffering from low birthrates what consequences does this have on elections? Based on a system dynamics model we are able to simulate different voter groups. The conclusions are alarming. We show that without a change in the voting system elections probably loosing their forward-looking perspective. Not the future will be key factor for election but preserving the current situations. This will be at the expense of our next generation.

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System Archetype Analysis on Some Problems of Chinese Enterprises Cross-border M&A

China's entrance into the WTO is a new departure in China's opening to the outside world. With the implementing of "Going-global" strategy, cross-border M&A of Chinese enterprises has become an inevitable trend. This paper uses systems thinking and system archetype theory to identify some typical problems in the process of Chinese enterprises' cross-border M&A. By analysing the merger between Chinese D' long Group and German Fairchild Dornier, we could draw a conclusion that companies should focus on locating the source of the problem, rather than developing remedies for the short-term symptoms. In the process of

cross-border M&A, Chinese enterprises need to concern if they have had the ability to merge and integrate the target companies effectively, especially the capability of post-M&A integration.

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The Dynamics of Urban CBD and RBD A case Study of Guangzhou

The city center is one of the major social, economic and political indicators of a city. Although urban centers have been the focus of urban studies, the dynamics of city centers have not been fully explored. In the case of Guangzhou, with the urban expansion and development, the original city center has gradually lost the competitiveness in attracting and keeping the producer service sector and tends to rely more and more on tourism and recreation industry. At the same time, the new center takes the opportunities to attract the producer service investors and generates a producer service industry clusters in that area. As a result, the former multiple functioning center is spitted into two centers - Recreational Business Center in the old city and the City Business Center in the new city. The study attempts to apply the system dynamics theory to build an initial model to examine the process of the formation of the multiple specialized centers in Guangzhou and provide a pilot model for the further development of a more realistic and complex model.

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Integration of Real and Monetary Sectors - System Dynamics Macroeconomic Modeling

This is the third paper of a series of macroeconomic modeling that tries to model macroeconomic dynamics on the basis of the principle of accounting system dynamics developed by the author. Money supply and creation processes of deposits were modeled in the first paper, while second paper built dynamic determination processes of GDP, interest rate and price level. In this paper, these two separate models are integrated to present a complete macroeconomic dynamic model consisting of real and monetary sectors. The integrated model is aimed to be generic, out of which some macroeconomic behaviors are shown to emerge. Specifically equilibrium growth path, business cycles and government debt issues are discussed in this paper.

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Systems Thinking on the Demand and Training for International Business Talents

China's entrance into the WTO has further integrated its economy into the whole world. Economic globalization has not only generated excellent opportunities for China's economic development, but also created a vast demand for international business talents. However, in reality, the training of this kind of talents is far from satisfying the huge demand gap. What even worse is that talents requirement and training have gotten into a shortsighted and utilitarian condition. This paper uses systems thinking and systems archetypes theory (including the "shift the burden to the intervenor" archetype and the "eroding goals" archtype) to

identify this phenomena and disclose the potential complex social factors. It provides the foundation of scientific methodology in understanding and dealing with these issues. Additionally, it offers a new standpoint of international talents demand and training based upon a strategic perspective.

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System Dynamics Approach to IT/IS Outsourcing at the Perspective of Knowledge Management

In recent years, due to a lack of expertise, many organizations have been devoting large portions of their budget to outsourcing. Outsourcing is now often regarded as a solution for all problems. However, the lack of clear understanding of the effectiveness of outsourcing could lead to many problems in organizations even though outsourcing is known to provide advantages to some organizations. Moreover, outsourcing could have a negative effect on knowledge management in some aspects. There have been and continue to be numerous studies into outsourcing; however, their findings primarily relate to cost reduction in short-term. Regardless of increasing demands on outsourcing and the importance of knowledge management, little research has focused on decisionmaking structure from knowledge management perspective. This paper attempted to quickly identify promising movements with potentially significant effects on IT/IS outsourcing.

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To investigate players' behavior when price variable is put in the Beer Game

Beer Game was developed by Slaon School of Management which didn't add price variable into the game. The reasons were：(1) As long as there is time delay, it will induce dynamic complexity. (2)If there is price variable, maybe we can't observe patterns and structure in the Beer Game. In this research, we try to add the price variable into the Beer Game to verify the statement made by Slaon School of Management. Besides, we can explore whether it will influence players' decision or not. The learning effects would be what we concern about. After modeling and some real tests, we found that bullwhip effect still exists, and it's much apparent then before. Besides, players are affected by price variables. From discussions after the game, we can find players lack of systems thinking, they have misperceptions of feedback and get used to put blame on others. Those learning effects are almost the same as traditional Beer Game induced. However, the Beer Game with price variable can conclude many behaviors made by players.Compare with the Basic Beer Game, adding the price variable seems too hard for the players to experience the structure produce behavior.

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Application of an Empirical Dominance Analysis Method on Various Model Structures: An Experimental Study

One of the empirical (behavior-oriented) approaches in the SD literature is the Behavior Pattern Index proposed by Saleh (Saleh, 2002). In this study it is aimed to perform the proposed behavior-oriented approach in different systems under differing conditions and test its performance in these settings. Also it is aimed to propose some extensions to this study where appropriate. Four basic models are used as a test bed; a single stock linear model (population birth-death), a second order linear model (modified 'simple oscillator'), a first order non-linear one (capacity constrained population) and a two level non-linear model (simplified market growth). As a conclusion of the limited number of test runs, employing BPI and PBP in dominance analysis seems to be a promising approach. A simply modified index, which is normalized PBP seem to perform better for tracking respective importance of loops. One of the concerns related to the method was its sensitivity to numerical dimensions of the variables. Although there is some suspicion about its applicability to large models, this method is evaluated to be a valuable tool in studying the relation between structure and behavior.

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Understanding Community Empowerment Process : A Case Study of a Rural Locality in Indonesia

In developing countries, many community empowerment efforts, which consist mainly of building the community's capability to fulfill its needs, failed to achieve the desired results. Counter-intuitively, sometimes the dependence to external agents grew even stronger. The paper is a preliminary attempt in elaborating factors that contribute to the success of empowerment process using system dynamics modeling. The case study is a poor village in Indonesia which received an infrastructure aid from a UN-agent in the form of Microhydro Plant to be managed for improving the community welfare. The model shows that empowerment is a feedback process influenced by many factors, and that capacity building to manage the plant is a learning process to be gone through by the community itself. Nonetheless, once this capability is achieved, the resulted capacity and awareness play significant role to improve the community's life quality. This model is expected to evoke other efforts to build a more comprehensive understanding of community empowerment process, and hopefully will encourage the local government to try new approaches for higher rate of successful implementation.

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Levels of Confidence in System Dynamics Modeling: A Pragmatic Approach to Assessment of Dynamic Models

This paper provides an overview of the literature in assessment of system dynamics (SD) models to substantiate a pragmatic framework intended to guide model testing, refinement and evaluation. It recaps the predominant philosophy of science embraced in the field, and its implications for model validation. It reviews tests for building confidence in SD models. In this literature, SD is presented as a relatively uniform approach to dynamic modeling. However, surveys of the field paint a different picture, containing surprisingly diverse forms of practice. We draw upon this breadth of existing practice to develop our framework. We propose five components of practice: 1) system's mapping, 2) quantitative modeling, 3) hypothesis testing, 4) uncertainty analysis, and 5) forecasting/optimization. In light of the proposed framework, we reclassify tests for assessment of dynamic models across these five practical categories. We believe this is useful to tailor tests to specific modeling efforts, guide model testing in different phases of model development, and to help conduct partial assessments of levels of confidence.

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Using System Dynamics Approach in Integrated Urban Water Management

About 7 million residents live in Tehran, the capital of Iran. In 2004, water authority of the city supplied about 1000 million cubic meters of fresh water. Increasing water demand in this city will require more 500 million cubic meters per year in 2020. Bridging this gap between supply and demand needs powerful management tools. In this study, Tehran's urban water system has been modeled by System Dynamics (SD). SD uses computer simulation on systems around us and to show why our social and physical systems behave the way they do. SD model of Tehran includes water supply sources, demand sources (as domestic, irrigation and industry uses) and management tools (Wastewater collection and treatment, inter-basin water transfer and demand management). Three scenarios and their impacts on water balance have been studied by the SD model. The model shows that extension of wastewater network will reduce groundwater resources. Inter-basin water transfe and demand management tools will improve water supply but the water transfer is more applicable in bridging the water shortage gap. The model gives sensitive and valuable results needed for Tehran's water management authority and its methodology is applicable in other cities especially in arid / semi arid regions.

Plenary Sessions

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Dynamic Decision Research: From Mis- to Right Perceptions

Equipped with interactive simulations and acting as behavioural decision researchers, system dynamicists have established a typology of dynamic decision errors. Contrary to initial predictions from experimental economists and some decision scientists, findings of systematic deviations from optimal decision behaviours persist in dynamic and feedback rich environments. Pragmatic investigations into whether various training programs might help mitigate decision errors have provided some insights into the fact that subjects do not apply insights easily within or between dynamic decision tasks. – However, no comprehensive framework to help design of interactive learning environments that aim to mitigate decision weaknesses has resulted yet. In order to help formulate such a framework, this presentation reviews five different research streams: Static judgement and behavioural decision- making; Dynamic decision-making; Education and improvement; Problem solving and Higher level frameworks. Indeed rediscovering Forrester's position that much data resides hidden in decision makers' mental models, the review indicates that effective learning approaches in dynamic decision must adress both analytic and intuitive cognitive processes separate and in combination. Documented failures in achieving productive improved mental models is re-evaluated in this framework, and suggestions for further research outlined.

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Participatory Modeling of Endangered Wildlife Systems: Simulating the Sage-grouse and Land Use in Central Washington

The Greater sage-grouse (Centrocercus urophasianus) occupies the sage brush habitats of Western North America. Large population declines in the last several decades have made it a candidate for possible listing under the Endangered Species Act. Listing was recently avoided in part because seventy local working groups are developing long-range management plans in conjunction with federal and local agencies. The Foster Creek Conservation District, a working group in Douglas County, Washington, saw the potential for system dynamics to synthesize known sage-grouse dynamics and local land use patterns to support development of their Habitat Conservation Plan and subsequent land management decisions. The resulting model is providing insights into the cropland and shrub steppe ecosystems of Douglas County and the management scenarios which may prevent the sage-grouse from an endangered status. The model is designed to facilitate and support land use management decisions through the collaborative exploration of model parameters and simulated scenarios.

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Defining the Policy Space for Disaster Management: A System Dynamics Approach to U.S. Flood Policy Analysis

This paper shows how a system dynamics model can be used to identify policy alternatives and scenarios for a policy space in a natural hazard policy analysis. In this paper, I will present a system dynamics model of the problems faced by decision-makers in a community that experiences flooding. While current policy analysis for hazard mitigation focuses on benefit-cost analysis, I argue that system dynamics can be used to improve the policy analysis and compliment the traditional approach. In this paper, I present a system dynamics model and policy space to illustrate the effectiveness of system dynamics in two respects. First, a system dynamics model designed with a policy space in mind provides the policy analyst with a "map" that effectively identifies policy levers and scenarios in the system. Second, by linking structure with behavior in the policy space, the policy analyst can quickly compare the model behavior of several key indicators over multiple scenarios. The policy space constructed from the system dynamics model identifies both qualitative and quantitative differences in policies. Including a system dynamics model in a policy analysis provides a deeper understanding of the causal structures, which compliments the traditional benefit-cost approaches and improves the overall quality of the analysis. Key words: policy analysis, natural hazard, flood, mitigation, extreme event, public administration, disaster management, agenda setting.

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Moving from Risks to Opportunities: A Process to Manage New Product Transitions

As a consequence of faster time-to-market and shorter product life cycles, companies today introduce new products more frequently. While new products can potentially bring tremendous value, they also pose enormous challenges as companies are most vulnerable during new product transitions. Due to the high stakes of new product transitions, planning and execution cannot be overemphasized. Nevertheless, our discussions with product transition teams suggested that a recurring handicap during transitions was the lack of a formal process to guide managerial decisions. This work develops a process to facilitate decision making during new product transitions. The proposed process analyzes the risks impacting a transition, identifies a set of factors across departments tracking those risks, monitors the evolution of these factors over time, and develops a playbook mapping scenarios of risks and responses. Our studies show that the transition process helps level expectations across the organization, lessens the chance and impact of unanticipated outcomes, and helps synchronize responses among different departments.

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Manufacturing start-ups in the automobile industry

Automobile manufactures are facing shrinking product lifecycles and increasingly complex production and product technologies. Both of these phenomena pressure production facilities to begin full scale operations at a point when the underlying process technology is still poorly understood. Consequently companies suffer from substantial yield losses which can dramatically affect the economics of the product, the production facility, and business. The manufacturing start-up will be defined as the time span equal to the difference between 'time- to-market' and' time- to- volume'. A major goal of automobile manufacturers is to reduce the 'time–to-market', however they cannot evaluate the effects on the 'time- to- volume'. This paper will give insight into these interdependencies and compare two policies for the management of changes during manufacturing start-up.

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Business Dynamics for Strategic Development

This paper examines the role of system dynamics in corporate strategic development. A framework for strategic development is introduced based on an analogy with feedback control. The strengths and limitations of the analogy are discussed. The basic framework is then extended to include strategic rehearsal as a 'virtual feedback process' at the corporate level to test and modify strategic initiatives before and during implementation. System dynamics is one effective way to provide such virtual feedback. An example is given based on a modelling project for a company in fast-moving consumer goods. The purpose of the project was to investigate the strategic implications of a new product launch in a highly competitive industry. There is a description of how the model was conceptualised with the management team and a review of simulations that were helpful in assessing the strategic initiative. The paper concludes with comments on the insights from the project.

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System Dynamics and Operational Research: Common foundations and new developments

The relationship between the fields of System Dynamics and Operational Research has not always been close and convivial. This is perhaps surprising, considering the strong overlap in ideas that the fields display in their modern form. However, this talk will go back to the roots of the two fields, exploring the parallels in the historical development of both during the Second World War. There will also be a foray back to the Ancient World via the Second Punic War to consider a famous precursor to whom both fields might look for their founding ideas. Finally, a recent development which both confirms and strengthens the links between the two fields will be discussed.

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Recruiting Clients to a Community-Based HIV-Prevention Program: A Dynamic Model

We present results from a preliminary system dynamics model of problems in recruiting clients to a hypothetical HIV prevention program. Efforts in HIV prevention emphasize moving programs of demonstrated efficacy to community settings. However, little is known about how these programs interact with contextual elements of service delivery to determine the feasibility of implementation. The section of the model we present here focuses on the stocks and flows associated with attracting, enrolling, and graduating a steady flow of clients into small-group workshops and highlights paradoxes in providing this type of program in the community. We test two policies that either focus on monitoring the recruitment rate or monitoring the graduation rate. Despite its superiority in real-life experiments for producing behavioral change, our model suggests that small-group workshops are a highly inefficient means to change the behavior of a target population over a ten-year period of time.

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Investigating Model Behavioural Analysis: A Critical Examination of Two Methods

Two methods for model behavioural analysis are implemented on a simple 2nd order non-linear model. The results of applying Ford's behavioral approach are compared with those obtained using both system-wide and variable-specific loop eigenvalue elasticity analysis. Differences in the division of the time span into analysis intervals are identified as are discrepancies in the outcomes. The effort required for implementation and the necessity for automation also differ substantially. We consider Ford's method readily understandable, whereas the mathematically more powerful eigenvalue elasticity analysis poses difficulties in this regard. Future directions for research on model behavioural analysis are identified based on the results of this critical comparison and the learning associated with our development of a prototypical automated model behavioural analysis framework.

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Offensive KPI's: Coordinating strategy and operations in interorganizational service supply networks

Service supply chains have changed over the last decade from internal and integrated operations to interorganizational supply networks where many interdependent organizational units provide fast and high-quality services to demanding customers. All these units have their own strategic interests and unaligned operations. The issue of how to coordinate strategy and operations in these decentralized supply networks is of paramount business relevance, especially in innovation-driven industries such as telecom. In this presentation, an approach is presented to overcome this issue. Suppliers that normally are rated on aspects that are under their direct control, so-called "defensive KPI's", can instead be rewarded for their contribution to end-customer related performance items, such as the percentage of error-free orders. These so-called "offensive KPI's" arise only from a thorough and shared understanding of the root causes of operational performance across organizational boundaries. Such understanding is created through group-model building meetings with staff involved , using system dynamics methodology. In doing so, both the "soft" and the "hard" aspects are confronted. This approach is described in a case involving the turnaround of the buyer-supplier relation between KPN Telecom, a medium-size European Telco, and Atos Origin, a leading ICT services provider in Europe, that the author supervised directly.

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System Dynamics - A Field of Study, a Methodology or Both?

Practitioners of System Dynamics have long lamented the slow rate of acceptance of System Dynamics by business, government, academics and other organizations. Essential to the acceptance of any new idea or innovation is the ability for its advocates to clearly and simply state what the concept is. This paper investigates the idea that a part of the problem may be attributable to the practice of its practitioners to position System Dynamics as both a field of study and an applied methodology. This mixed message creates a classic Watzlawick double bind paradox in which the field appears to define the methodology and the methodology appears to define the field. This paper argues it can not be both if the Society expects to succeed in its goal to increase the acceptance of System Dynamics, whether it be a field or a methodology. The author proposes an approach for decoupling the method from the field by developing separate terms and distinct operational definitions for each that are not self-referential and explores the implications to the method, the field and its practitioners.

Special and Convened Sessions

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Military Roundtable

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AnyLogic Software Users' Group Meeting

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Business Roundtable

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SDS Membership Roundtable

Are you a previous, potential, or current member of the System Dynamics Society? We'd like to hear from you. How can our Society best serve you? The Society provides many activities and services for members, including the SD Review, our annual conference, chapters and SIGs, to name just a few. Attend this roundtable and tell us what you value about Society membership, how our activities and services do or do not enhance this value, what we could improve, and what you'd like the Society to offer in the future. Our membership has grown significantly in the last several years, yet each year many members choose not to renew their memberships. If you are a previous member, we'd like to know why you left. If you are a member, we'd like to know specifically what you value in your membership and how the Society can continue to serve you well in the future. Finally, our Society membership is primarily male, white, North American or European, and over the age of 35. If you do not match this description, we'd like to hear your suggestions for recruiting and retaining more members like you, including women, people of color, young people, and people from additional geographic regions.

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System Dynamics PhD Colloquium

The 7th PhD Colloquium is an event of the System Dynamics Student Chapter. The objective of the colloquium is to bring together PhD students working on foundations, techniques, tools, and application of System Dynamics in a variety of disciplines and to give them the opportunity to present and discuss their research in a constructive and international atmosphere. Plenary presentations allow for common problems encountered by PhD researchers using System Dynamics to be identified. Each presentation will be followed by an extended discussion session , providing a unique opportunity for learning among all attendants. Combined with a poster session scheduled in the afternoon, we expect the all-day colloquium to be an exciting event. SD PhD Colloquium <contact@sdphdcolloquium.org>.

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Vensim Users' Group Meeting

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isee and iThink Users' Group Meeting

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Special Convened Session: Dynamics of Health Reform

The session on the Dynamics of Health Reform, hosted by the Health Policy Special Interest Group (HPSIG), will focus on factors promoting and resisting change in different countries' health care systems, possible unintended consequences of reform efforts, and potential leverage points for achieving significant reform. The session builds on insights developed in a session at the 2005 ISDC in Boston. This year, the session will begin with brief presentations of a number of papers that address health care system change and reform in several countries and at scales ranging from neighborhoods in cities to regions and states to an entire country. After these presentations, attendees will discuss common features across these several countries and scales, as well as from their own countries, and synthesize some useful "rules of thumb" for health reform that benefit from a dynamic perspective. We hope to also have some local experts from the Netherlands in attendance who can draw on their country's recent experience with reform. The balance of the session will be spent on thinking about next steps for the HPSIG, further development of its web site and Wikipedia, and potential focus for a session at the 2007 ISDC.

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Special Session: Sixth Annual Modeling Assistance Workshop

Modeling assistance is available at the conference to enable modelers to discuss their specific modeling questions with modeling coaches. Modeling assistance opportunities include two workshops, as well as the possibility of assistance at any time during the conference. Assistance is available for modelers with all levels of modeling ability, from beginner to advanced, with questions about a specific model that modelers are developing or studying, to something that modelers don't understand in one of the system dynamics textbooks or software packages. Questions may range from problem articulation, formulation of a dynamic hypothesis, formulation of a simulation model, model testing, or policy design and evaluation. Modelers should bring whatever materials they need to describe their modeling question, including pencil and paper, books, posters, or laptop computers. Spectators are welcome to observe modeling assistance coaching sessions.

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Prospective Conference Host Meeting

The annual conference is the most important activity of the Society, and therefore hosting it is a very important contribution to the Society. In addition, being a host for this event can bring fame (sorry, no fortune) to the hosting individuals and organizations, and attract local interest in the field. In this meeting we will discuss the timetable and activities involved in pre-paring a bid to host the conference, the requirements for a successful bid, and the requirements for a successful conference. We will also discuss the Society's schedule for conference site rotation, and the role of SIGs and Chapters in conferences. Please attend this meeting if you have any interest in hosting a future conference.

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Economic Roundtable

Economic Roundtable will bring together people interested in the interface between economics and system dynamics. We will share information and ideas about professional activities, as well as lay out a research agenda for the future.

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Environmental Roundtable

In the 2005 meetings, the old "Environmental Dynamics" SIG has simplified its name to "Environmental", has re-defined its scope, and has clearly defined its objectives – as published in the October 2005 SDS Newsletter. To continue this work, the focus of the 2006 Environmental Roundtable shall be on activity. The goals of this Roundtable are to (a) identify and classify by scope and objectives the activities (e.g. R&D

projects, consultancy) of its individual members, and (b) attempt to sketch a joint strategy (e.g. policy, guidelines) that will allow the SIG to achieve its common objectives, followed by examples of typical projects to expect in the future. Participants will be asked to contribute to the Roundtable with (a) facts about their relevant professional activities, regarding the first goal, and (b) with ideas about joint activities at the strategy or project aggregation level, regarding the second goal. Activities identified or suggested in this Roundtable can be presented in future conferences and/ or academic journals.

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B2B Gathering (Business-to-Business Gathering)

The B2B Gathering is a meeting for early arrivals at the Business day. Before the plenary presentations start participants are welcomed by the local host and have a chance to meet with local and international visitors to the conference. The B2B Gathering is followed by special activities related to the conference theme 'The dynamics of innovation in networks' throughout the Business Day.

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Peer Review Dialog (2006)

The SDS highly values peer review for ISDC programming and SDR publishing and encourages broad participation. The Peer Review Dialog allows ISDC attendees to participate in improving the process. Those who have participated in SDS peer review and those who desire to participate are encouraged to attend. The dialog intends to start with these questions: 1. Participation - What actions should be utilized to encourage and recognize participation in the peer review process? How can the Chapters and SIG's more fully contribute to the process? 2. Description - The 2005 Peer Review Dialog identified an opportunity to describe some key components of the peer review process. How can review guidelines improve the value of reviews? How can reviewer profiles increase alignment of reviewers with submissions? 3. Integration - How should the peer review processes for the ISDC and SDR be integrated to improve quality of presentations and publications while minimizing overlap? However, the dialog is not limited to these topics. Your contributions on these and other topics are invited to increase the value of the peer review process to the system dynamics community.

Exhibitor Demonstrations

Exhibitor demonstrations will be held during the lunch breaks on Monday and Tuesday to showcase products and services in practice.

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K-12 Open Discussion

Everyone interested in K-12 education (ages 5-18) is encouraged to come and participate. We will enjoy hearing from participants briefly about what is happening around the world with your students. Most of the session, however, will center on the future. What should we be doing

with our children? How can we be effective with this age group? What plans of action can we agree on for the future? Background reading for this session can be found on the Creative Learning Exchange Website (www.clexchange.org). The Implementation section has many good articles for browsing. Two that are especially pertinent are "Bringing System Dynamics To a School near You" and "The Future of System Dynamics and Learner-Centered Learning in K-12 Education: The Essex Report.".

Powersim Users' Group Meeting

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Workshops

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Creating Multiplayer Online Simulation Games

This workshop will teach you how develop your own online simulation game using existing system dynamics models and technology readily available online. Massively Multiplayer Online Games (MMOs) such as Second Life and World of Warcraft have tens of millions of users worldwide and have dramatically increased the popularity and awareness of online games and simulations. The problem is that blockbuster games like these require blockbuster movie-sized budgets. However, there is now an opportunity to create smaller multiplayer games on a limited budget. Instead of a massive multiplayer worlds, system dynamics-based business simulations can be transformed online into small multiplayer simulation villages that teach specific lessons to participants through a web browser. During the workshop, Michael Bean will demonstrate how to create multiplayer web simulations, discuss commonly occurring web simulation design challenges and potential solutions, and show examples of web simulations that have been used by thousands of users. Michael will also provide a series of guidelines for creating simulations online. Michael will provide handout booklets, sample simulations, and sample HTML pages that can be used to create your own first web simulation.

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Getting Started with AnyLogic Software and Agent Based Modeling

This is a hands-on introductory workshop. The attendees will be able to build models of both System Dynamics and Agent Based kinds using AnyLogic, and, if time allows, a hybrid model. The goal of the workshop will be not just to demonstrate the software but also to discuss when agent based modeling makes sense and what needs to be done to make it practically useful. You can download and install AnyLogic prior to the workshop, or we can supply you with the CDs and demo keys in Nijmegen.

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Getting Started with Vensim

System Dynamics is about understanding complex systems. As Jay Forrester points out human beings are not able to understand the implications of multiple interacting feedback loops. To support us in this

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endeavor, therefore, we need software. Vensim is one of the available software products that fully supports system dynamics and this workshop is an introduction to using it.

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Getting Started with STELLA and iThink

This workshop will be an introduction to building and communicating system dynamics models using STELLA or iThink software. This workshop is intended for people who are relatively new to the field or do not have experience using STELLA or iThink. The session will be conducted as a hands on workshop and demonstrate basic techniques for building, analyzing and communicating simple simulation models. Participants should bring their own computers with STELLA or iThink Version 9 installed or arrive one half hour early to install the software.

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Modeling Dynamic Systems: Lessons for a First Course

"Modeling Dynamics Systems: Lessons for a First Course" provides a set of materials that enable educators at the secondary and college levels to teach a one-semester or one-year course in System Dynamics modeling. These lessons are also useful for trainers in a business environment. Developed for beginning modelers, the lessons contained in this book can be used for a core curriculum or for independent study. Systems thinking software like STELLA offers an opportunity to create visual models that actively engage students in the study of a wide variety of problems. Creating a model allows for "real-time" analysis of dynamic behavior and a more stimulating environment in which to glean insight. The lessons include some of the classic System Dynamics problems (population change, resource sustainability, drug pharmacokinetics, spread of an epidemic, urban growth, and more). Developed over 14 years, the lessons in this book provide an easy-to-use set of teaching materials that are paced gently enough for novice modelers. Students learn to create progressively more sophisticated models, testing their structures as they proceed. Feedback analysis is integral to the lessons. Guidelines for an independent project and an outline for a technical paper explaining the creation process, are included.

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System Dynamics Lessons for K-12 Students

Workshop participants will experience an elementary school (ages 8 – 10) lesson and a middle school (ages 12 – 14) lesson designed to teach some of the basics of system dynamics. Some lessons appropriate for secondary school (ages 15 – 18) will be presented. Student work will be demonstrated. The workshop will conclude with a brief discussion of available curriculum resources, strategies, challenges and pitfalls of implementing the study of dynamics systems in K-12. A CD containing helpful articles and sample lessons will be made available to each participant (at no cost).

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How to make System Dynamics applicable for Business and Politics? - Best Practice Approach

SD is one of the most promising methods to solve complex problems. In spite of the development of different simulation tools and approaches in the past, SD is still not in wide use. How come?? What are the main barriers for applying SD in buiness and politics?? How to overcome them?? This questions were the main driving forces for initiating a new international R&D project called "Decision Support" aiming at building up a network in which researchers, educators, consultants, software engineers and practitioners interact to share ideas and experiences for improving policy-making-processes, and at developing a new best practice approach for applying System Dynamics in business and politics. For this, different users have been involved in order to define their requirements like easy to use (e.g. avoiding time and cost-intensive training or moderation services), transparency, workflow-oriented approach, integrating different approaches (e.g. the causal-loop-diagram concept and the stock-and-flow-view) as well as linking the qualitative analysis with the simulation part. As a results of the project a new best practice approach which can be used intuitively has been developed, tested, and improved in cooperation with different users. Be invited to discuss and evaluate the best practice approach at our workshop.

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Designing Simulation-Based Learning Environments: Helping People Understand Complex Systems

Simulation-based learning environments, often called management flight simulators or Microworlds, are excellent tools for giving people without modeling experience an intuitive understanding of complex systems. Learning environments let them experience the dynamics of complex systems without the hurdle of having to build models "from scratch".

This workshop will deal with the design of learning environments, their user interfaces, underlying models, and workshop formats for experiencing them. Special attention will be paid to methods of displaying information to help users understand causes of the behavior they encounter and thereby make better decisions and learn more quickly. The workshop will also emphasize the importance of design based on clear learning objectives that reflect limitations in decisionmakers' mental models, model boundaries consistent with those objectives, stakeholder involvement, early testing of prototypes, and evaluation and ongoing modification of the finished product. The presenter will show a number of examples from his own work from health care, education, the news media, and other fields. He is also eager to make the workshop interactive and would like to hear about other people's experiences with learning environments and from people with models they are interested in turning into learning environments.

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Using Webquests & STELLA with Preservice Teachers

Webquests are widely used in education to structure problem solving activities for elementary and secondary students. This workshop will review the use of webquests in general and the adaptation of them to foster systems thinking. In particular, this workshop will consider approaches to preparing preservice teachers to use systems thinking. Examples will be presented from the work of preservice teachers that includes a range of disciplines. The concluding discussion will focus upon the utility of various approaches to use with preservice and in-service educators.

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UK

Soft Systems Methodology Today

Soft Systems Methodology (SSM) has been developed beyond the understanding described by Prof Peter Checkland in his keynote address to the 1999 Wellington conference. Informed by using SSM in real world consulting assignments, and building on the impact of recent ideas, Dr Brian Wilson and his colleagues have improved their understanding of the relationship between systems ideas and systems thinking, and real world problems. They have devised practice based approaches to undertaking effective interventions in purposeful organisations, and communicating the results of systems thinking to the problem owners to improve organisational performance. This workshop provides a practical introduction to these methods.

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A Modular Approach To System Dynamics Modelling Using Multi-Dimensional Arrays

Many structures found in system dynamics models cannot be adequately described using scalar models. Often it is necessary to use arrays to provide sufficient analytical power. The use of arrays is often avoided

because they can be difficult to visualise, and hence difficult to define. This workshop examines the types of problems which are addressed using system dynamics models which incorporate multi-dimensional array structures. How to define array problems will be clearly explained. Attendees will work in small groups to define sample array structures for a range of modelling problems. Already defined array modules will be introduced and explained. Attendees will develop skills in combining these to produce working models of supply chain, logistics, human resource management problems and other problematic situations.

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Modeling Demonstration Workshop

Demonstrating the benefits of simulation modeling to new audiences is not an easy task. Models that solve dynamic problems may take weeks, months, or even years to develop. Audiences new to System Dynamics may have a hard time relating model behavior to the real world problem because of the separation between their experience of the world and a model embedded in a computer. A partial exception is the Beer Game, which demonstrates dynamic problems immediately, although this is not often followed by simulation. This workshop teaches the art of creating dynamic experiments that involve an audience, and translating those experiments into working simulation models. The dynamic experiment is brief, exciting, memorable, and involves workshop participants. Behavior data is captured "real-time" for later use. The audience discusses their observations of the experiment and their understanding of the data. A dynamic hypothesis is elicited from the audience and a simulation model created "on the spot" by participants to reproduce the observed dynamics. The aim of the workshop is to introduce newcomers to System Dynamics modeling and to help experts to effectively demonstrate the value of simulation.

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Workshop on the Development of Large System Dynamics Projects

This workshop will lay the foundation for effective development of large system dynamic modeling projects using Vensim. A key to this development process is the automated combining (merging) of models. Even small system dynamics models can be fairly complex. When the size of the model gets large, such models often become unwieldy, difficult to maintain, and hard to understand by any but the original modeler involved in the development. This workshop will provide specific methods in standardization to alleviate these issues and apply concepts from modern software development practices to system dynamics modeling. Participants will learn techniques for modularization, normalization, and the application of automation tools. While much of the workshop is specific to Vensim, many of the concepts are generic and can be applied to any system dynamics simulation environments.

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Introducing System Dynamics into your Strategy Capstone Course

Participants will see a demonstration of a system dynamics assignment developed for the capstone stragey course, at the California State University, Chico. The assignment has been developed and tested over a three year period. In this assignment the student works through 11 SD models, developed using the MYSTRATEGY software. The models focus on growth strategy, simulating the growth of Home Depot Inc. 12 years of actual data are provided for validation. Participants will receive all material necessary to conduct their own assignments, including all 11 SD models, the list of questions and instructions, and the data (in Excel).

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Introducing Management and Strategy Dynamics

This will be useful for people with an interest in using system dynamics with management – whether in corporate or non-commercial setting. Important barriers to management acceptance of system dynamics include the seemingly 'foreign' language it requires – feedback, stocks, flows etc – and what looks like quite technical modelling. Yet the underlying principles are closer to management thinking that may seem to be the case. This workshop will go through a process that can bring executives from a regular description of an issue they face or plans they may have to a simple, dynamic picture of the same thing. This can readily include evidence from the situation, and may [optionally] be turned into a working simulation. The workshop will take participants through the key steps in the process: - specifying how things are changing through time - showing how resources drive that performance - explaining how those resources are built and sustained - showing how resources depend on each other - understanding how this interdependence gives rise to feedback that may help or hinder progress in building performance into the future.

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Exploring life plans with the Jane Sloan Microworld - a model of personal resources and feedback

This workshop will be most relevant for people in higher education and management, though others may find it interesting too. Participants have a chance to explore a professional person's adult life, via a PC game built on an underlying system dynamics model of certain resources and feedback effects that individuals need to balance. You decide on your objectives for 'Jane', a mid-career professional, in three broad areas - how much importance she places on her own well-being, on having a high income and getting rich, and on building a strong family and social network [i.e. health, wealth and happiness!]. Having set these aims, you

help Jane build and sustain the resources she needs, by prioritising how she spends her time. Some of her resources are work-related, such as professional skills and experience, reputation with colleagues and the level of her job. Other resources are personal - her family, friends, and the community. Still others concern her well-being, such as fitness and stress. This workshop will largely involve participants' active participation with the game, though will also include some input on its underlying principles, and how it is being used at London Business School.

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